SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY 1904.

GENERAL PHYSICS.

225. *Compound Pendulum.* **R. R. Tatnall.** (Phys. Rev. 17. pp. 460–468, Dec., 1903.)—In any compound pendulum, if a portion of the mass, having its centre of gravity initially in the axis of rotation, be moved continuously downwards, the period will pass through a minimum value, and the centre of oscillation will first rise and then fall. The period reaches its minimum value when the distance of the centre of gravity of the movable mass from the axis is one-half the length of the equivalent simple pendulum. In a reversible pendulum with a movable bob, when the centre of gravity of the movable bob is at its upper reciprocal position, the centre of oscillation of the pendulum is at the lower knife-edge. If the movable bob be continuously lowered, the centre of oscillation continuously rises, reaching a maximum height when its distance from the centre of gravity of the movable bob is equal to the distance of the latter from the axis. When the centre of gravity of the movable bob reaches a position as far below the mid-point between the knife-edges as it initially was above this point, the centre of oscillation is again at the lower knife-edge. After this it continues to fall indefinitely.
A. D.

226. *A Four-piece Skew Mechanism.* **G. T. Bennett.** (Engineering, 76. pp. 777–778, Dec. 4, 1903.)—The author describes a skew mechanism of four pieces, having the axes of rotation neither parallel nor concurrent. By means of it rotation may be immediately communicated between two crossing shafts by the use of a single connecting rod. The four links of the mechanism satisfy the following conditions: (1) Two alternate links have the same length a and the same twist α, while the other two have the same length b and the same twist β. (2) The relation $\sin \alpha/a = \sin \beta/b$ is to be satisfied. (3) In putting the linkwork together the terminals of the central axes are brought into coincidence, the central axes thus forming a skew quadrilateral with its alternate sides equal. The kinematics of the mechanism are discussed. The zero positions are neither change-points nor dead-centres.
W. S.

227. *Applications of Nickel-Steels.* **C. E. Guillaume.** (Archives des Sciences, 15. pp. 249–286, March; 403–432, April; 514–544, May; 623–639, June; 16. pp. 172–190, Aug.; 278–299, Sept.; and pp. 501–525, Nov., 1903.)—These papers give a long and exhaustive account of the properties and applications of the nickel-steel alloys. These alloys (if they contain over 26 per cent. nickel) are reversible in the sense that, when brought back to a definite temperature after going through any cycle of temperatures, they exhibit the same properties as before. This is detailed for expansion and elasticity coefficients. Much matter is given under the following heads: Secular changes, effects of different alloys, elastic anomalies, applications to standard bars and wires for geodetic purposes, applications to time measures (pendulums, chronometer balance springs, spirals), to levelling instruments and angle-measuring instruments, to bimetallic thermometers, to the Threlfall gravity balance, and to instruments where a hermetical metal-glass joint is required. [See also Abstracts Nos. 1183, 1184, and 1200 (1903).] J. W. P.

228. *Elasticity of Metals.* **G. Angenheister.** (Ann. d. Physik, 11. 1. pp. 188–201, April, 1903. Extract from Inaugural Dissertation, Berlin, 1902.) —Young's modulus and the rigidity modulus were determined experimentally, and the following conclusions deduced: For the same substance, increase in density leads to increase in Young's modulus and the rigidity modulus, but to decrease in Poisson's ratio and in the bulk modulus. The experiments were made on aluminium, copper, two kinds of steel, and two kinds of nickel-steel. Cooling has the same effect as increase in density. In the case of Wood's alloy and Rose's fusible metal the bulk modulus increases with temperature up to the melting-point. For silver-copper alloys the rigidity increases with the proportion of copper, while the bulk modulus increases up to the alloy of lowest melting-point (one equivalent of silver to one of copper), and then falls to that of pure copper. Schaefer's statement that Poisson's ratio is a linear function of the temperature up to the melting-point is not a general truth. W. S.

229. *Measurement of Air Velocity and Pressure.* **A. F. Zahm.** (Phys. Rev. 17. pp. 410–423, Dec., 1903.)—The author points out the advantages of direct observation of each of these separately. A new type of anemometer is described, based upon Pitot's tubes, with a delicate differential pressure gauge and a double pressure nozzle on a pressure-tube, which on being held along stream transmits the impact pressure from one nozzle and the static pressure from the other to the cups of the differential pressure gauge. The former represents the total head, the latter the pressure head. Their difference is the velocity-head $\rho v^2/2g$, which gives the velocity v. Comparison with other instruments, particularly the Dines pressure-tube anemometer, is made, and references given to the literature on the subject. A. D.

230. *Analysis and Synthesis of Vibrations.* **E. Grimsehl.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. pp. 303–311, Oct. 15, 1903.)—The author describes a photographic method of studying vibrations by recording them on a falling dry plate. It is applicable to recording phenomena of Leyden-jar sparks, the singing arc, &c. A demonstration apparatus for composition of vibrations is described. A number of steel rods in a frame, of such lengths that their summits form a simple harmonic curve; above this a similar frame and set of rods forming another simple harmonic curve; then the upper frame is slid horizontally to an extent corresponding to any desired difference of phase, and the upper set of rods are allowed to sink down so that they stand upon the rods beneath them. The tops of the conjoined rods now form the compound harmonic curve required. So for any greater number of frames and sets of rods. A. D.

231. *Geometric Constitution of Ether.* **R. de Saussure.** (Archives des Sciences, 16. pp. 608–610, Nov., 1903.)—In this paper, which is but an instalment of the writer's work, it is sought to show that all the mechanical units can be reduced to geometric units. Time is a line, the geometric unit of one dimension. Space is of three dimensions. Force he represents by a unit of two dimensions, *i.e.*, a surface. Mass is the ratio of force to acceleration, or $m = f \Big/ \frac{df}{dt}$, from which it would appear that mass should be of one dimension, *i.e.*, a line, but this deduction may not accord with the writer's views. So finally he says kinematics, or the science of pure motion, depend on combining time with space, statics on combining force with space. S. H. B.

232. *Apparatus for Demonstrating the Principle of Conservation of Motion.* **Lermantoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 34. No. 7b. pp. 367–371, 1902.)—The author describes an apparatus suggested by Hicks for demonstrating the conservation of amount of movement. According to Hicks, Newton's "vis impressa" should be translated by "amount of movement" instead of by "acting force," as most render it. Now, though the correctness of this translation cannot be doubted, the notion of force is familiar to every one, while that of "amount of movement" seems to be rather artificial. It was therefore necessary to construct an apparatus which would allow this principle in its modified form to be directly demonstrated. This apparatus consists of two ballistic pendulums, each rotating around two parallel axes. A. G.

233. *Meteorology of Geneva and the Great St. Bernard in* 1902. **R. Gautier.** (Archives des Sciences, 16. pp. 541–568, Nov.; and pp. 702–730, Dec., 1903.)—The six or eight daily observations [see Abstract No. 879 (1903)] have been continued at Geneva, but reduced to three on the St. Bernard; only the data for the observations taken at 7 a.m., 1 and 9 p.m., are now published, but the means for Geneva are based on the complete records. The records concern temperature, atmospheric pressure, humidity, winds, rain, and snow, and nebulosity and insolation (for Geneva only), during the thirteen months, December 1, 1901, to December 30, 1902. The nebulosity and insolation observations have, after an interruption caused by the death of M. Micheli, been taken up by his son, J. Micheli. H. B.

234. *Cloud Observations at Simla.* **R. de C. Ward.** (Science, 18. p. 732, Dec. 4, 1903.)—Between June, 1900, and January, 1902, only 47 good photogrammeter observations were obtained, according to which the average height above sea-level for the year is, at Simla, 37,664 ft. for cirrus clouds, 25,083 ft. for cirro-cumulus, 14,528 ft. for cumulus, and 13,143 ft. for fracto-cumulus; the cirrus height mentioned is 30,440 ft. above Simla, and cirrus clouds range there between 16,000 and 40,000 ft., reckoned above sea-level. These figures are reproduced from W. L. Dallas: Report on Cloud Observations at Simla, Ind. Met. Mem. XV., Part II., Calcutta, 1903. H. B.

235. *Insolation in Switzerland.* **H. Dufour** and **C. Bührer.** (Archives des Sciences, 16. pp. 417–434, Oct., and pp. 526–540, Nov., 1903.)—Sunshine recorders of the Campbell-Stokes type have been installed since 1884 at fourteen Swiss stations. In the first part of the paper Dufour gives an analysis of the records for the period 1891 to 1900 from the seven stations at Bâle, Berne, Zürich, Lausanne, Lugano, Davos, and Säntis; a special study is

made of the sunshine at Lausanne during the fifteen years 1887 to 1901. The second part concerns observations, taken by both the authors with Crova actinometers, between 11 a.m. and 1 p.m. in the years 1896 to 1903 (Aug.), at Lausanne and Clarens. The solar radiation shows two maxima, the one in April, the other in August. Since December, 1902, the radiation values have, owing probably to volcanic dust, been exceptionally low, so that Wolfer could not observe reversals of protuberance lines, nor even obtain good images of protuberances. A simple relation between the intensities of radiation and of polarisation (Cornu photo-polarimeter) is not established, the parallelity of the respective curves holding only for the middle of the day. [See also Abstract 1330 (1903).] H. B.

236. *Polar Climate in Time the Major Factor in the Evolution of Plants and Animals.* **G. R. Wieland.** (Amer. Journ. Sci. 16. pp. 401–430, Dec., 1903.) —The author concludes that life probably originated at the North Pole, about which the continents are grouped, or at both the poles. If we assume the globe to have once been molten, there would have been at the poles less solar heat, and, what is more important, less heavy lunar tides than in the primitive equatorial lava seas; and even if we assume the earth never to have been in the molten state, the heat conditions at the poles would have been more favourable to life. The paper is essentially of geological and biological interest. H. B.

237. *Vibrations and Stability of a Gravitating Planet.* **J. H. Jeans.** (Roy. Soc., Phil. Trans. 201. pp. 157–184, April 4, 1903. Roy. Soc., Proc. 71. pp. 136–138, Dec. 27, 1902. Abstract.)—The author investigates the effect of gravitation, as a factor tending towards instability, in the case of a solid or liquid spherical planet. The principal vibrations and the frequency equation of a spherically symmetrical solid are then discussed, the solution obtained being, in its main points, very similar to that given by Lamb for a non-gravitating sphere, but the inclusion of the gravitational terms considerably complicates the analysis. The author then contends that observations of the planets of the solar system show that the phenomena of planetary evolution are mainly due to gravitational rather than to rotational instability. He argues that the earth has probably passed through a pear-shaped stage, with a gradual transition, through a series of ruptures, to its present approximately spherical form, and suggests that traces of the pear-shaped configuration are still retained. [See also Abstract No. 959 (1903.] G. W. de T.

238. *Solar Prominences and Terrestrial Magnetism.* **A. L. Cortie.** (Astrophys. Journ. 18. pp. 287–293, Nov., 1903.)—While there is a general connection between sun-spots and magnetic storms, the relation is, in the author's opinion, not one of efficient cause and effect. Observations of prominences at Stonyhurst during the years 1880 to 1892 having confirmed that the activity of the prominences is in direct proportion to the activity of sun-spots, the author demonstrates, with the aid of Fenyi's prominence tables for the years 1887–1888, that no conclusion can be drawn as to any relation between prominences and magnetic storms such as N. Lockyer and W. Lockyer have suggested. Prominences occur in latitudes in which spots are not found, but are not separated from spots and faculæ, and while some few prominences seemed to be connected with magnetic storms, others equally high and active were totally unconnected with any extraordinary movements of the needles. H. B.

239. *Spectrographic Observations of Standard Velocity Stars.* **E. B. Frost** and **W. S. Adams.** (Astrophys. Journ. 18. pp. 237–277, Nov., 1903.)—Results of a year's systematic work by the authors with the Bruce spectrograph at the Yerkes Observatory. Three spectrograms were to be taken from each of ten selected stars—one at opposition, the other two thirty days before and after. Some alterations to the spectrograph are described. The plates were measured by Gaertner screw comparators having 0·001 mm. divisions. The figures of each observer are tabulated separately, and the possible errors and corrections discussed. Control plates were taken of the Moon, Mars, and Venus, and the velocities obtained therefrom are compared with those computed from Campbell's formulæ. The discrepancy of the theoretical from the mean values in no case exceeds 0·7 km. per second, the mean error being only + 0·1 km. per second. The final radial velocities which the authors give are: α Arietis, −13·7; α Persei, −2·1; β Leporis, −12·4; β Geminorum, +3·4; α Crateris, +47·4; α Boötis, −4·8; β Ophiuchi, −11·1; γ Aquilæ, −1·8; ε Pegasi, +6·8; γ Piscium, −10·9; ι Aurigæ, +19; ε Leonis, +5·5: γ Cephei, −41·2 km. per second. The authors consider the present investigations more reliable than any previously carried out by them. Further figures are to be published by other co-operators. H. F. H.

240. *Photographic Spectrum of Nova Geminorum.* **C. D. Perrine.** (Astrophys. Journ. 18. pp. 297–298, Nov., 1903. From Lick Observatory Bulletin, No. 37.)—Several negatives were taken of the spectrum of this star between April 2 and April 8; it consisted of bright lines and bands upon a continuous background, and extended from Hβ to λ = 3850. The general appearance resembles the spectrum of Nova Persei in April, 1901. The differences between the two spectra are given in the paper, the chief amongst which is perhaps the fact that the nebular line conspicuous in Nova Persei was absent in Nova Geminorum. The author considers that the differences are due to the different stages of development. [See Abstract following.] E. C. C. B.

241. *Spectrum of Nova Geminorum.* **H. M. Reese** and **H. D. Curtis.** (Astrophys. Journ. 18. pp. 299–306, Nov., 1903. From Lick Observatory Bulletin, No. 37.)—An account of a visual and photographic investigation of this spectrum, and the results showed that it was intermediate between that of Nova Persei in April, 1901, and in the following July. A detailed description is given of the differences in position and character of the bands in the two Novæ. Between April 1 and April 22 a considerable change was observed in the spectrum of Nova Geminorum. One band between Hβ and Hγ had moved 17 A.U. towards the red, making it more nearly coincide with a band observed in Nova Persei in 1901. A new band appeared near the Hγ band which may have been the first appearance of the nebular line λ = 4363, but this is doubtful. A further photograph taken on May 4 showed that, as far as could be seen from a poor negative, no further change had taken place. Reproductions of the negatives and measurements of the bands are given. [See also preceding Abstract.] E. C. C. B.

242. *Last Sun-spot Minimum, and Spörer's Law of Zones.* **J. Guillaume.** (Comptes Rendus, 137. pp. 898–900, Nov. 30, 1903.)—An examination of figures obtained at Lyons Observatory from Jan., 1901, to June, 1903. From these the author deduces Sept., 1901, as the time of minimum; also that spots in the higher latitudes of the sun begin to appear one year previous to the minimum, and disappear from the lower latitudes one year after that period. Spörer's law asserts that the spots begin to multiply equally in both latitudes directly after the minimum period, whereas the author's conclusion is that in the higher latitudes the spots commence to reappear before the critical period. [See also Abstract No. 891 (1903).] H. F. H.

243. *Total Solar Eclipse, May* 28, 1900. (Roy. Dublin Soc., Trans. 8, 5. pp. 65–88, Dec., 1903. Report of the Joint Committee of the Royal Dublin Society and Royal Irish Academy.)—Observations were made in Spain by **C. J. Joly, W. E. Wilson, H. Grubb,** and **A. A. Rambaut.** Two normal coronal photographs are reproduced. A third photograph shows the corona screened by a specially treated celluloid film which absorbed the violet end of the spectrum, the object being to find out how much of the apparent corona was due to atmospheric glare. The remaining photographs show two series of chromospheric spectra obtained by kinematograph at second and third contacts, taken with the object of determining the order in which the various lines appeared, and faded out; most of the lines disappeared in the order of their brightness, but the two strontium lines λ4078 and λ4216 faded earlier than others of the same intensity. A specially constructed kinematograph was used in which each exposure slightly overlapped the preceding one, to ensure that any flash lines which might appear should be recorded with certainty. Two sets of plates were used in the instrument, the image being successively transferred from one to the other by two mirrors at right angles moving up and down in their own planes. The principal feature of the coelostats, one of which is illustrated, is that they can be adjusted for latitude. The article concludes with a temperature chart taken on a screened Richard thermograph; this records a fall of temperature of the air of 8·2° F. during the eclipse. H. F. H.

244. *Spectrum of the Aurora.* **C. Runge.** (Astrophys. Journ. 18. pp. 381–382, Dec., 1903.)—Paulsen compared the spectrum of the aurora with that of the negative glow of a vacuum tube containing oxygen, nitrogen, and carbon monoxide, and concluded that there is a close connection between the two. The author points out that this is not very satisfactory, and that there is just as much evidence for the identity of the aurora and krypton spectra. The wave-lengths of the spectra are compared in the paper, but greater accuracy in the measurements of the aurora lines is needed. [The close resemblance between the green aurora line and one of the krypton lines was originally pointed out by W. Huggins.] E. C. C. B.

245. *Spectrum of o Ceti.* **J. Stebbins.** (Astrophys. Journ. 18. pp. 341–380, Dec., 1903. Dissertation at the University of California. From Lick Observatory Bulletin, No. 41.)—An account of an elaborate spectroscopic investigation of this star, in which several interesting facts have been noticed. The star, though of variable magnitude, has apparently a constant velocity in the line of sight of about + 66 km. per second. The spectrum consists of bright lines and dark absorption bands; amongst the bright lines $H\gamma$ and $H\delta$ were very strong, while $H\beta$ and $H\epsilon$ were apparently absent. $H\alpha$ was looked for visually, but was not seen. Measurements were made of the change in intensity of the bright lines and other portions of the spectrum as the star decreased in magnitude, and amongst other facts the two hydrogen lines Hγ and Hδ decreased in relative intensity, while a line $\lambda = 4571$ strongly increased. The author also considers that, as the bright lines are strongly shifted (to the violet, with reference to the dark line system) from their normal positions, apparently by causes other than radial velocity and pressure, it seems probable that some very considerable forces now unknown to us are at work. The variation in magnitude of the star is probably not owing to its having a dark companion, but is no doubt due to the action of internal disturbances. E. C. C. B.

246. *Variable Star* 1921 *W Aurigæ.* **J. A. Parkhurst.** (Astrophys. Journ. 18. pp. 309–328, Dec., 1903.)—A short summary is given of previous work by Ceraski, Blajko, Hartwig, and Esch. The instruments used were a 6·2-in. reflector, and 12-in. and 40-in. refractors, with equalising photometer attached. The variable's strong colour is shown by its photographic magnitude being 10·9, when visually it is 9·5. Photometric measures of the comparison stars, and the resulting magnitudes of 1921 W Aurigæ are tabulated in detail; also the visual comparisons by Argelander's method. Finally, a light curve is given showing the variation of 1921 Aurigæ through five cycles of approximately 276 days each, the maximum and minimum magnitudes being respectively 9·3 and 13·8. H. F. H.

247. *Observations on the Leonids and Bielids at Athens in* 1903. **D. Eginitis.** (Comptes Rendus, 137. pp. 965–966, Dec. 7, 1903.)—On November 14, 15, and 16, the Leonids seen numbered 12, 187, and 33 respectively, mostly of a red colour, moderate speed, and mean illumination of the fourth order. One, the most brilliant, lasted 75 seconds. The display reached its maximum between 3 and 4 p.m. on November 15. In position the radiants of these Leonids varied between $\alpha = 150°$ to $156°$; $\delta = +17$ to $+25$. Bielids appeared from November 22 to 24, with radiants $\alpha = 23°$ to $26°$; $\delta = 43$ to 46. They were mostly of the fifth order, red in colour, with short trajectories and high speeds, some being so rapid as to be scarcely visible. H. F. H.

REFERENCES.

248. *Automatic Mercury-jet Air Pump.* **L. Zehnder.** (Ann. d. Physik, 10. 3. pp. 623–646, Feb., 1903.)—The author describes in detail how an air pump of the Kahlbaum type can be made; various ways of joining glass tubes with the aid of sleeves and mercury seals are explained. H. B.

249. *Fedorow's Goniometer.* **K. Stöckl.** (Deutsch. Phys. Gesell., Verh. 5. 3. pp. 75–79, Feb. 15, 1903.)—A preliminary notice of a two-circle goniometer constructed by Fuess and capable of mechanically solving spherical triangles. G. E. A.

250. *Mercury Air-pump.* **F. Florio.** (N. Cimento, 5. pp. 233–242, April, 1903.)—The author gives a description of four patterns of a rotatory air-pump capable of producing a vacuum of one-570,000th atmosphere. A. D.

251. *A Novel Hygrometer.* **N. A. Hesehus.** (Jurn. Russk. Fisik. Chimičesk, Obščestva, 34. No. 7b. pp. 331–337, 1902.)—After many years' researches, the author has succeeded in designing a simple and convenient hygrometer, based on an immediate determination of the increase in the elasticity of water vapour, on saturation being reached, with a given volume of moist air. A. G.

252. *Seismometric Pendulum.* **E. Wiechert.** (Phys. Zeitschr. 4. pp. 821–829, Nov. 15, 1903. From Gerland's Beitr. z. Geophysik, 6. p. 435, 1903.)—A description and discussion of an astatic pendulum of great sensitiveness for earthquake recording. A. D.

253. *Hygrometers.* **G. Guglielmo.** (Accad. Lincei, Atti, 12. pp. 557–566, Dec. 6, 1903.)—A description of a form of apparatus for both weighing the vapour condensed by strong sulphuric acid and measuring the diminution of pressure or volume of the air when dried, without loss of time or incompleteness of absorption. A. D.

254. *Friction Brake.* **A. Hérisson.** (Comptes Rendus, 137. pp. 1035–1036, Dec. 14, 1903.)—A type of brake is described, based on variations in the internal diameter of a rotating cylinder, and the corresponding variations in the pressure exerted by a shoe pressing within the cylinder upon the walls of this, or gliding past the walls, according to the rotational position to which the shoe is brought. A. D.

255. *British Weights and Measures.* **G. Johnstone Stoney.** (Roy. Dublin Soc., Proc. 10. No. 2. pp. 6–23, May 2, 1903.)—The author proposes modifications of British weights and measures, which would simplify their metrical expression with smaller changes than those involved in the introduction of the metric system itself. G. W. de T.

256. *Synchronisation of Clocks.* **J. Andrade.** (La France Horlogère, Sept. 15, 1903. Summary in Archives des Sciences, 16. pp. 611–612, Nov., 1903.)—The author considers the theory, and arrives at a general formula comprising the methods of Foucault and of Cornu as particular cases. A. D.

257. *Joints Formed by Flexible Metal Strips.* **A. Mesnager.** (Comptes Rendus, 137. pp. 908–909, Nov. 30, 1903.)—The author points out the advantages of this kind of joint where rigidity is essential, for instance, in apparatus of precision which are to multiply very small displacements by levers. The joint has also been successfully used in bridge construction. W. S.

258. *Fall of Bodies.* **M. T. Edelmann.** (Phys. Zeitschr. 4. pp. 415–416, April 15, 1903. Communication from the Phys.-Mech. Instit. Univ. Munich.)—A description of apparatus for demonstrating the equality of time of free fall and oscillation period of a pendulum. A. D.

259. *Photographic Surveying.* **T. T. McIntyre.** (Feilden, 8. pp. 20–29, Jan., and pp. 108–120, Feb., 1903.)—For certain classes of survey the photographic method excels all others, and a knowledge of it is desirable for those whose duties are likely to carry them to countries in an earlier stage of development than Great Britain. Readers should note and correct one or two typographical errors on pp. 108 and 111 (ex. *sealed* for *scaled*, and *cone* for *cosine*, &c.). C. E. A.

260. *Barometric Corrections for Chronometers.* **P. Ditisheim.** (Comptes Rendus, 137. pp. 700–703, Nov. 2, 1903.)—There are variations in a chronometer, proportional to the atmospheric pressure. A. D.

261. *Approximate Solution for the Bending of a Beam of Rectangular Cross-section under any System of Load. Additional Note.* **L. N. G. Filon.** (Roy. Soc., Proc. 72. pp. 391–393, Nov. 21, 1903.)—In this note the writer gives corrections for some errors made in his paper on the above subject [see Abstract No. 37 (1904)], which Flamant had recently pointed out. The errors, he says, do not affect the general conclusions arrived at in that paper with regard to the beam under a uniform load S. H. B.

262. *Dielectric Cohesion of Gases at Low Temperatures.* **E. Bouty.** (Comptes Rendus, 137. pp. 741–742, Nov. 9, 1903.)—The dielectric cohesion of a gas at constant volume does not differ by 1 per cent. between −100° and +200° C. This cohesion, along with the index of refraction and possibly the dielectric constant, make up the list of properties of a gas which are independent of the temperature. It would seem that the minimum kinetic energy which an ion ought to have in order to enable it to ionise a neutral molecule is independent of the temperature. [See also Abstracts Nos. 1138 and 1306 (1903).] A. D.

263. *On the Ellipsoid of Elasticity.* **L. de la Rive.** (Archives des Sciences, 16. p. 610, Nov., 1903.)—The author commences with the statement that if the elastic forces are not all of the same sign, the tangential surface becomes a hyperboloid. He shows that the tangential force in a principal section is $\frac{a+c}{2}$, a and c being the axes of the hyperbola, and that its direction makes the angle 45° with x. S. H. B.

264. *Determination of the Primitive Form of Crystals.* **F. Wallerant.** (Comptes Rendus, 137. p. 1001, Dec. 7, 1903.)—Compare Abstract No. 87 (1902). T. M. L.

265. *Anomalies in Gravity: Geological Significance.* **de Lapparent.** (Comptes Rendus, 137. pp. 827–831, Nov. 23, 1903.)—The author traces the connection between anomalies in gravity and the broken nature of the strata beneath. A. D.

266. *Marine Soundings.* **A. Mensing.** (Zeitschr. Instrumentenk. 23. pp. 334–342, Nov., 1903.)—A description of a self-recording apparatus, based on differential manometers, to be sunk in open water not exceeding 200 metres in depth, and to record the variations in depth during a period of 30 days. A. D.

267. *Calculating the Tides by Means of Harmonic Constants.* **R. de l'Isle.** (Comptes Rendus, 136. pp. 992–994, April 27, 1903.)—The method for calculating the moment of high tide indicated by the author requires the preparation of two perpetual tables for combining the wave movements, and of one annual table which would answer for all ports. H. B.

268. *Nodal Lines in Sand, and Agglomeration of Pebbles.* **C. Maltézos.** (Journ. de Physique, 2. pp. 803–807, Nov., 1903.)—Ripples on the sand of sea beaches represent nodal lines, produced by the interference of waves and also of winds. The author, further, finds the pebbles occasionally arranged at almost equal distances. H. B.

269. *Capillarity of Solutions.* **J. Mathieu.** (Ann. d. Physik, 11. 1. p. 224, April, 1903.)—The variation of the capillarity-constant with the radius of the capillary recorded in a previous paper [see Abstract No. 534 (1903)] could not be confirmed by further experiments. T. M. L.

270. *Intensity Distribution over the Sun's Disc.* **H. Seeliger.** (Phys. Zeitschr. 4. pp. 343–345, March 15, 1903.)—An outline of the author's work on the above subject eleven years ago (Sitz. Ber. Münch. Akad., Nov., 1891) is given in connection with an article by Vogel on the same subject in the preceding number. G. E. A.

271. *Pyrheliometric Measurements made at Corleto in* 1898. **C. Chistoni.** (Accad. Lincei, Atti, 12. pp. 53–57, Jan. 18, 1903.)—An account of experiments made with a Violle actinometer in 1898 in the village of Corleto, which is situated about 7 km. from Modena. [See also Abstract No. 9 (1903).] D. H. J.

LIGHT.

272. *Electric Colour-projection Apparatus.* **F. C. Perkins.** (West. Electn. 33. p. 365, Nov. 14, 1903.)—A description, with two illustrations, of Miethe's three-colour projection apparatus made by Ernecke, of Berlin. It has three hand-feed arc lamps, each consuming 50 to 70 amperes, but with smaller carbons the lamps can be run with 10 to 20 amperes. The red, green, and blue filters act as coolers. The positive lantern slides are photographed through the proper filters, and measure 24 × 9 cm. These are cut into three parts, each 8 × 9 cm., which are then pasted on one larger plate of glass, which can be manipulated like a single slide. G. E. A.

273. *Light-filter for Ultra-violet Light, and Fluorescent Screen.* **D. A. Goldhammer.** (Phys. Zeitschr. 4. pp. 413–415, April 15, 1903. Phys. Inst. Univ. Kasan.)—To make a filter passing only ultra-violet light, put in a quartz vessel a solution one-fourth saturated with $CoSO_4$ and $NiSO_4$; strengthen it till no blue passes; cut off the remaining red by careful addition of Hofmann violet. A fluorescent screen for Röntgen rays can be made by putting 1 gramme of uranium nitrate in 4 grammes of water, adding 1¼ grammes NH_4F, collecting the precipitate formed, making up with gum arabic and painting the mixture on paper. A. D.

274. *Fixation of Photographic Negatives.* **E. A. Rogowsky.** (Journ. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. p. 607, 1903. Paper read before the Russian Physico-Chemical Soc. (Physics Section), Sept. 22, 1903.) —After developing (with hydroquinone) and washing a Lumière negative, the author placed the latter for drying in the diffused light of an ordinary room, when, after one week's stay there, the plate was found to have lost nothing of its detail and clearness on being fixed in the diffused daylight. The author feels sure that the negative could be exposed to diffused light without any fixation for considerably longer periods. In virtue of this interesting statement it would be possible to confine the operations necessary in photographing, especially when travelling, to developing and washing, which would considerably shorten the time one has to spend in the dark room, leaving fixation to a more convenient time. A. G.

275. *Optical Resonance.* **A. Bock.** (Phys. Zeitschr. 4. pp. 339–341, March 15, and pp. 404–406, April 15, 1903.)—The author describes experiments of a similar nature to those of Wood [see Abstract No. 1659 (1902)] and Kossonogoff [see Abstract No. 1848 (1903)], which he published in 1896. Water vapour is blown with a pressure of 10 cm. of Hg through a 1·7-mm. nozzle into air which has been bubbled through an acid such as nitric or sulphuric. The colour of the vapour may be made to change from blue to green, yellow or red, by diminishing the concentration of the acid. The results obtained are given in *résumé* as follows: (A) Water particles with diameters of the order of magnitude of the wave-length of light λ exhibit optical resonance in diffused light, the particles reflecting only light of wave-length λ. (B) With central illumination, and water vapour between the light source and the eye, diffraction effects are perceptible so long as the particle diameter is greater than λ; if the latter is equal to λ, optical resonance occurs, and if less than λ the water particles become invisible. (C) With intense illumination by parallel rays, reflection perpendicular to the ray takes place when λ is greater than the particle's diameter. These reflected rays are polarised at right angles to the incident ray. Rays for which λ is equal to the diameter excite resonance and are not polarised, nor are those rays for which λ is smaller than the diameter. G. E. A.

276. *Colours of Allotropic Modifications of Silver.* **J. C. Blake.** (Zeitschr. Anorg. Chem. 37. 2. pp. 243–252, Nov. 6, 1903.)—Of the numerous phenomena presented by the allotropy of silver so far published, the beautiful colour effects observed by Carey Lea (American Jour. Sc. 37. pp. 476, and Phil. Mag. vol. 31, pp. 238, 320; vol. 32, p. 337) seem to be the most remarkable. As no satisfactory explication of this phenomenon was forthcoming, the author repeated most of the experiments with "allotropic" silver and "colloidal" silver so far described, as well as a series of experiments on the so-called "sub-salts" of silver. He draws the conclusion that the whole of the colour effects observed may be accounted for on the hypothesis of the existence of three and possibly four allotropic modifications of silver, each of which exhibits one characteristic colour in the reflected light and another colouration, nearly complementary, in transmitted light. In mirrors permeable to certain wave-lengths of light, the colourations for reflected and transmitted lights will be mixed in the inspection with ordinary light, so as to annihilate one another. The variety of colours arising from the combination of these several modifications of silver, as well as the shades produced by foreign colouring substances, are carefully studied. The four allotropic modifications of silver, the existence of which is presumed in this paper, are as follows:—

Form of Silver as termed according to the Colour most readily Observable.	Colour in Reflected Light.	Colour in Transmitted Light.
White silver	Nearly white	Nearly opaque, even in thinnest strata.
Blue silver	Yellow gold	Blue
Red silver	Indigo blue	Red
Yellow silver	Indigo blue	Yellow

Of these four different modifications, the yellow modification is possibly a variety of red silver. The conditions under which these different modifications, as well as any other composite modifications, are produced, are fully discussed. A. G.

277. *Transparency of Sea Water.* **Thoulet.** (Comptes Rendus, 137. pp. 748–749, Nov. 9, 1903.)—With the help of a grease-spot photometer the author finds that the curve connecting the depth of the layer of turbid water, through which a source of light remains visible, and the amount of fine kaolin suspended in the water, is an equilateral hyperbola whose shape is hardly influenced by the intensity of the light and its distance. The Eastern Mediterranean, which, according to Luksch [see Abstract No. 1030 (1902)] is transparent to a depth of 33 m., would thus contain 0·00012 gm. of kaolin, or its equivalent per litre. H. B.

278. *Intensity of the Solar Illumination.* **C. Fabry.** (Comptes Rendus, 137. pp. 973–975, Dec. 7, 1903.)—With the aid of a Lummer-Brodhun photometer the author compares the intensity of sunlight with that of an electric incandescence lamp, the light from which is passed through a solution of ammoniacal copper sulphate. Concordant results have been obtained at Marseille with the sun within 25° from the zenith, the sun when at the zenith giving at sea-level an illumination equivalent to that of 100,000 bougie décimales (1 bougie = 1·13 Hefner unit) at 1 metre distance, or about 1,800 bougies per sq. mm. of apparent disc surface. The total radiation would, without atmospheric absorption, amount to about 0·15 or 0·20 watt per bougie. H. B.

279. *Determination of the Maxima and Minima of Transparency.* **C. Camichel.** (Comptes Rendus, 137. pp. 788–789, Nov. 16, 1903.)—In the course of researches on indophenols, the author and Bayrac have shown the advantage of determining maxima and minima of transparency, in order to characterise bodies whose absorption spectra show bright or dark bands sometimes extending the whole width of the visible spectrum. The determination can be made with any spectrophotometer, provided that the intensity of one of the two spectra compared can be diminished in a known ratio independent of the wave-length. To start with, the spectra should be exactly similar and of equal intensity. Now interpose the absorbing medium in the path of spectrum II., reduce spectrum I. by a certain amount κ, and find the wave-length λ where both spectra are equally bright. Repeat the process for a series of values of κ, and construct the curve (λ, κ) for the coefficient of transmission as a function of the wave-length, and also the curve $\left(\frac{\lambda + \lambda'}{2}, \kappa\right)$ which is the locus of centres of chords parallel to the axis of λ. The point of intersection of these curves, which is well defined, gives the wave-length corresponding to a minimum of transparency. The apparatus actually employed was a Gouy, the two nicols being replaced by a rotating disc with open sectors. When the velocity of rotation is sufficient to give a continuous impression, the light is weakened in a ratio independent of the velocity, and equal to the surface of the open sectors divided by the total surface. An ordinary spectroscope may be transformed into a spectrophotometer by the addition of a second collimator fitted with a piece of half-silvered glass, the ocular being replaced by a hole in a thin plate at the focus of the observing telescope. For reducing the intensity a pile of white glass plates might be employed instead of rotating sectors, but is not so good. A. E.

280. *Luminous Efficiency of Vacuum-tube Radiation.* **E. R. Drew.** (Phys. Rev. 17. pp. 321–354, Nov., 1903.)—The tube radiation is measured by means of a radiometer with a fluorite window, the efficiency being obtained from the ratio of the deflections with and without a water cell between radiometer and tube. With air at a pressure of 1 mm., the luminous efficiency of vacuum-tube radiation is about 0·20. A considerable portion of the radiation is due to a single line, or narrow group of lines, at $\lambda = 4·75\ \mu$. The paper deals also with variation of efficiency and of total radiation with current and temperature, potential gradient in the tube and the energy distribution in the spectrum. G. E. A.

281. *On an Integral of the Equations of Wave Motion which corresponds to Doppler's Principle.* **E. Kohl.** (Ann. d. Physik, 11. 1. pp. 96–118, April, 1903.)—Doppler's Principle, though generally accepted as fundamental, has

never received strict mathematical demonstration. This the author proposes to give in the present paper. He supposes a source of harmonic vibrations which are propagated through space with velocity B. The source itself moves uniformly, in direction taken for axis of x, with velocity C. The source is supposed to have been initially at P, or distant x from the origin, and to the left of it, so that x is negative, and to reach the origin O at time $t = 0$. It was at P at time $t = \frac{x}{c}$. When the source reaches the origin, the disturbance has reached a spherical surface described about P as centre with radius Bt. P_1, P_2, &c., are successive points between P and O, at each of which the vibrations have the same phase as at P. When the source has reached O, the disturbance starting from P_1 has reached a distance $P_1O \cdot B/c$ from P_1, and so on for each of the points P. M is a point on the sphere of radius Bt about P, M_1 a point in PM on the sphere described about P_1. M_2 the same for P_2, and so on. The points M, M_1, M_2 . . . lie on a curve which becomes the envelope of the lines MP, M_1P_1, &c., if the periodic time of the source, and therefore PP_1, P_1P_2, &c., are supposed very small. The writer says that this curve is the apparent ray from the source to M. Inasmuch as the phenomena are the same for all points in any circle perpendicular to x, we may treat them in one plane only. Let ρ be the ordinate, x the abscissa of a point in the curve MM_1. . . . Then we have by geometry $\rho^2 + (x - Ct)^2 = B^2t^2$ and $d\rho/dx = \rho/(x - Ct)$, whence by elimination of t, he finds for the equation to the curve, writing $C = Bk$, and $\rho = x/u$,

$$x = Cu(u + \sqrt{1 - k^2 + u^2})^{\frac{1}{2k}} / (ku + \sqrt{1 - k^2 + u^2}),$$

also $PM = (kx + \sqrt{(1 - k^2/\rho^2 + x^2)})/(1 - k^2)$. He then introduces the general differential equation for the wave motion in the form $d^2V/dt^2 = B^2\Delta V$, and obtains a solution $V = R \sin 2\pi/\tau_0(t - S/B)$, in which R and S are functions of x, y, z, t, namely—

$$R = 1/\sqrt{(1 - k^2)\rho^2 + (x - Ct)^2},\ S = [k(x - Ct) + \sqrt{(1 - k^2)\rho^2 + (x - Ct)^2}]/(1 - k^2).$$

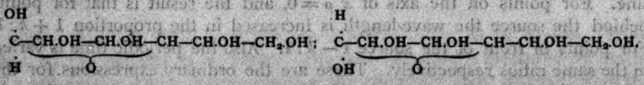
The case of infinite τ_0, or of zero harmonic disturbance, is discussed with reference to the works of Heaviside, Lorenz, and Morton. The equation corresponding to the Doppler Principle is $V = [1/\sqrt{(1 - k^2)\rho^2 + (x - Ct)^2}] \sin (2\pi/\tau_0)$ $\left[t - \frac{k(x - Ct) + \sqrt{(1 - k^2)\rho^2 + (x - Ct)^2}}{(1 - k^2)B}\right]$, or the same with cosine instead of sine. For points on the axis of x $\rho = 0$, and the result is that for points behind the source the wave-length is increased in the proportion $1 + k : 1$. For points in front of the source $1 - k : 1$. Also the periodic time is varied in the same ratios respectively. These are the ordinary expressions for the Doppler Principle. The results are finally extended to points not on the axis of x in a somewhat more complicated form. S. H. B.

282. *Rotary Polarisation Mechanically Produced.* **A. W. Ewell.** (Phys. Rev. 16. pp. 178–180, March, 1903. Abstract of paper read before the Amer. Phys. Soc. Oct. 25, 1902).—Plane polarised light traversing jelly subjected to twist has its plane of polarisation rotated in the opposite direction to the twist. [See Abstract No. 52 (1900).] Quantitative relations were determined. The rotary polarisation is greatly increased by an elastic envelope (rubber tube round jelly cylinder). Longitudinally applied, compression increases the rotation: elongation diminishes it: and the changes of length (abscissæ) and rotations (ordinates) give exponential curves. Hydrostatic pressure produces no effect. If the longitudinal strain be kept constant, if relaxation effects be eliminated (by reading the actual zero of twist before and after each twist), if small twists precede greater, and if the temperature remain sensibly constant, the rotary polarisation is approximately constant for a given twist; and it is closely proportional to the fourth power of the twist. The rigidity of a jelly cylinder (gelatine and glycerine) is greatly increased by longitudinal elongation. A theory is deduced from compression along one spiral and elongation along another during a twist. A. D.

283. *Polyrotation* (*Mutarotation*) *of the Sugars.* **E. Roux.** (Annal. Chim. Phys. 30. pp. 422–432, Nov., 1903.)—The author proposes structural and stereoisomeric formulæ for the α-, β-, and γ-glucose of Tanret, and shows by velocity-measurements that the rate of transformation of α into β obeys the logarithmic formula (first order reaction). He shows that a 6 per cent. solution, containing α and γ in the proportions of 36·73 per cent. α, 63·27 per cent. γ, behaves just like a solution of the β form. This fact leads him to conclude that in such a mixture the α and γ forms are passing into the β form with the same rate at every instant. Similar conclusions are arrived at with respect to α-, β-, and γ-lactose. [The author has been obviously led astray by a false interpretation of the facts. See Lowry, Abstract No. 285 (1904).] F. G. D.

284. *Rotatory Power of Maldiamide, Maldi-n-propylamide and Maldibenzylamide.* **J. McCrae.** (Chem. Soc., Journ. 83. and 84. pp. 1324–1327, Dec., 1903.)—Measurements of the densities and specific rotations of the above-mentioned amidic derivatives of malic acid in glacial acetic acid and pyridine. The results show that the benzyl group behaves, in its effect on rotatory power, more like an aliphatic than an aromatic radicle. F. G. D.

285. *Studies of Dynamic Isomerism.* I. *Mutarotation of Glucose.* **T. M. Lowry.** (Chem. Soc., Journ. 83. and 84. pp. 1314–1323, Dec., 1903.)—The author regards the β-glucose of Tanret as a mixture of the two isomers, α-glucose, $[\alpha]_D = 105°$, and γ-glucose, $[\alpha]_D = 22°$. These latter behave, therefore, as tautomeric ("dynamic") isomers. As shown by E. F. Armstrong, α-methyl glucoside gives a glucose of high, β-methyl glucoside one of low rotatory power. It is probable therefore that, as suggested by Simon, α- and γ-glucose are the corresponding lower homologues, and possess a γ-oxide ring, *i.e.*,



$$\underset{H}{\overset{OH}{\dot{C}}}\underbrace{-CH.OH-CH.OH-}_{O}CH-CH.OH-CH_2.OH\ ;\quad \underset{OH}{\overset{H}{\dot{C}}}\underbrace{-CH.OH-CH.OH-}_{O}CH-CH.OH-CH_2.OH.$$

Figures and curves are given which exhibit clearly the effect of acids and alkalies on the velocity of mutarotation of α-glucose. The effect of alkalies is enormously greater than that of acids. Neutral salts have very little effect. The mutarotation which occurs in pure ("conductivity") water cannot be due to traces of alkali, as on adding a small quantity of acid—enough to certainly neutralise any possible alkali present but not enough to appreciably affect the velocity (as acid *per se*)—the velocity of mutarotation is not altered. The action of water is probably connected with its ionising power. F. G. D.

286. *Influence of Cyclic Radicles on Optical Activity: Tartaric* ar- *and* ac-*Tetrahydro-β-naphthylamides, Furfurylamide, and Piperidide.* **P. F. Frank-**

land and **E. Ormerod.** (Chem. Soc., Journ. 83. and 84. pp. 1342–1348, Dec., 1903.)—The rotations of the amides were observed in pyridine solution; the strengths being between 1 and 5 per cent.; several solutions of the same substance were examined and the mean taken. *Tartaric di-ar-tetrahydro-β-naphthylamide.*—The mean value (pyridine solution) of $[\alpha]^{20}_{D}$ was + 204·8°, whence $[M]^{20}_{D} = +885°$. Prepared by heating the base with free tartaric acid to 140° C., it melted at 186° C. and $[\alpha]^{20}_{D} = +208·4°$.—*Tartaric di-ac-tetrahydro-β-naphthylamide.*—This gave $[\alpha]^{20}_{D} = +58·4°$ and $[M]^{20}_{D} = +238°$. Prepared from free tartaric acid, the same constants were obtained. *Tartaric di-furfurylamide.*—Examined in the same way in pyridine $[\alpha]^{20}_{D} = +98·8°$, and $[M]^{20}_{D} = +303°$. Prepared from free tartaric acid, the same constants were observed. *Tartaric-di-piperidide* was practically inactive. F. S.

287. *Influence of Various Substituents on the Optical Activity of Tartramide.* **P. F. Frankland** and **A. Slator.** (Chem. Soc., Journ. 83. and 84. pp. 1349–1367, Dec., 1903.)—The method used to prepare the amides was described in the previous paper. [See preceding Abstract.] For the rotation they were generally dissolved in pyridine. The amide and hydrazide, however, were dissolved in water. All rotations were taken at the same temperature—viz., 20° C. Aromatic groups considerably raise the rotation, whereas the effect of aliphatic radicles is much smaller. The dextro-influence of the anilide and toluidide groups is as follows: *p*-toluidide > *m*-toluidide > anilide > *o*-toluidide. Tartaric hydrazide has a slightly higher molecular rotation than tartramide; the phenyl-hydrazide unexpectedly exhibits a much lower rotation than either of the former compounds. On the other hand, the hydrazones have extremely high rotations. The benzylamide ranks with the fatty amides, and is not nearly so high as the aromatic amides. In addition to the molecular rotation, the properties of these amides are given, some of which have not hitherto been prepared.

SUMMARY OF ROTATIONS $[M]^{20}_{D}$.

Amide.	Solvent.			Amide.	Solvent.		
	Pyridine.	Water.	Methyl Alcohol.		Pyridine.	Water.	Methyl Alcohol.
Tartramide	...	+158°	+210°	Hydrazide	...	+170°	...
Anilide	+739°	...	600				
p-Toluidide	793	...	...	Benzylidene hydrazide ...	+554°	...	...
o-Toluidide	667	...	...				
m-Toluidide......	730	...	...	Furfurylidene hydrazide ...	736	...	...
α-Naphthylamide	400	...	...	Hydrazone of acetophenone	397	...	...
β-Naphthylamide	1160	...	...	Tartranil	272	216	268
Methylamide ...	278	240	...	Tartaric-*p*-Toluil	366	...	280
Ethylamide	279	256	...				
Benzylamide ...	300	...	...	Diacetyltartaric *o*-toluidide ...	80	...	...
Phenylhydrazide	(<80)	...	...				

F. S.

288. *Spectra of Imperfect Gratings.* **A. A. Michelson.** (Astrophys. Journ. 18. pp. 278–286, Nov., 1903.)—Gratings acting by opacity and by retardation

are considered in turn. For the first kind, and for the case of a plane wave of given frequency falling normally on the grating, the intensities of the spectra are shown to be in the proportion of $\frac{\pi^2}{4}$ for the central image and $1, 0, 1/3^2, 0, 1/5^2$, &c., for the spectra in their order, this agreeing with the results obtained by Rayleigh. The case of the reflection grating is next worked out, and expressions are found for the distribution of light in the image for given conditions as regards the strength of the ruled lines and their spacing. The effect due to linear displacement of the rulings is given and verified by experiment, and a systematic error in Rowland's table of wave-lengths is indicated. The paper closes with a general theory of the ghosts which accompany spectral lines when the ruling is affected by a periodic error. [See also Abstracts Nos. 70 and 71 (1904).] G. E. A.

289. *Radiations from Sulphate of Quinine.* **F. C. Gates.** (Phys. Rev. 17. pp. 499–501, Dec., 1903. Abstract of a paper presented at the meeting of the American Physical Society, Oct. 31, 1903.)—Sulphate of quinine becomes temporarily phosphorescent when heated, and can discharge an electroscope. Unlike the radiations from radio-active substances, which appear to be unaltered either by time or temperature, quinine sulphate radiations are only rendered apparent by great temperature changes, and cease after a short time. They are completely absorbed by a thin sheet of aluminium, and largely by a few mm. of air. The current obtained varies greatly with the direction of the field. Since these effects are accompanied by marked phosphorescence, it is possible that they are caused by very short waves of ultra-violet light, such as Lenard has shown to be active in ionising gases, and therefore that the ionising action is altogether different from that of radio-active substances. R. S. W.

290. *Scintillations Produced by Radium.* **H. Becquerel.** (Comptes Rendus, 137. pp. 629–634, Oct. 27, 1903.)—From the observations made by W. Crookes with his *spinthariscope* the author was led to resume his former study of the phosphorescence produced by the radiation from radium. He has repeated the experiments carried out by Crookes with screens of hexagonal blende, and agrees with him that the scintillations are produced by the α-rays only. The crystals of the zinc sulphide under the impact of the α-rays alter progressively and undergo cleavage unequally, according as they are more or less large. The cleavage of the crystals employed is accompanied by the emission of light, even when the cleavage is produced mechanically. The author has obtained the effect by crushing crystals of hexagonal blende between glass plates. He considers that the facts observed establish a very strong presumption in favour of the hypothesis which attributes the scintillation to cleavages produced irregularly on the crystalline screen by the continuous action, more or less prolonged, of the α-rays. J. J. S.

291. *Scintillation of Phosphorescent Zinc in the Presence of Radium.* **T. Tommasina.** (Comptes Rendus, 137. pp. 745–747, Nov. 9, 1903.)—Referring to Becquerel's paper [see preceding Abstract] on the scintillations produced by radium when near a crystalline zinc sulphide screen, the author confirms the hypothesis put forth in that paper. He has obtained revivification of the scintillations on the screens by means of electric discharges in their neighbourhood. The action appears to be limited to the surface, and the luminous phenomenon may be electrostatic in origin and may be due to the irregular production of small discharges at the places where the modifications of the cleavages occur. The intermittent character of the phenomenon may be due to the fact that each little crystal only becomes sufficiently electrified to produce a discharge after it has received a great number of impacts from the particles constituting the α-rays. J. J. S.

292. *New Effects of* N-*rays.* **R. Blondlot.** (Comptes Rendus, 137. pp. 684–686, Nov. 2, 1903.)—When the *n*-rays are directed upon a small source of light such as a little electric spark, or a small flame, the source of light is seen to increase in brilliancy. In the further experiments described in this paper the action of the *n*-rays on a body reflecting light from some outside source was observed. The *n*-rays were caused to fall on a strip of white paper illuminated by means of a beam of light proceeding from a small flame shut up in a box with a vertical slit. The *n*-rays were obtained from an Auer burner surrounded by a chimney of sheet iron, in which was a rectangular opening, the whole being enclosed in a lantern of sheet iron pierced with a window facing the opening in the chimney, the window being closed with a thin sheet of aluminium. In front of this window was placed the piece of white paper lit up as described. If the rays were intercepted by a sheet of lead or by interposing the hand the small rectangle of paper was found to become darker, and its contours were less sharply defined. On removal of the lead or other screen the paper appeared brighter. The light diffusely reflected by the band of paper is increased by the action of the *n*-rays. It was also proved that the light from a slit reflected by a steel knitting needle, or a plane bronze mirror, was increased when the reflecting surface was exposed to the *n*-rays. Similar effects were obtained when light was reflected from a polished face cut in a block of quartz, whether the *n*-rays reached the surface from the outside or through the mass of the quartz from inside to outside. No action was found to take place on refracted light. A Nernst lamp replaces the Auer burner advantageously, as it gives more intense *n*-rays. J. J. S.

293. *Storage of* N-*rays by certain Bodies.* **R. Blondlot.** (Comptes Rendus, 137. pp. 729–731, Nov. 9, 1903.)—The *n*-rays from an Auer lamp, after passing through an aluminium screen, are concentrated by a quartz lens on phosphorescent sulphide of calcium. On extinguishing and removing the lamp, the sulphide remains phosphorescent; with the lamp lit, the sulphide becomes dim on interposing a lead or wet paper screen. The quartz lens was found to have become a source of *n*-rays, the action on the sulphide ceasing when the lens was removed, and reappearing when the lens was replaced. It further appeared that this secondary emission proceeds from the whole mass of the quartz, and such substances as Iceland spar, fluor spar, glass, gold, lead, platinum, silver, zinc, &c., have the same property. Aluminium, wood, dry or wet paper, and paraffin wax do not possess the property. On the other hand, pebbles or bricks which had been exposed to sunlight gave out *n*-rays for four hours without sensible diminution. Dryness of the surface is essential for the exhibition of the phenomenon, the slightest coating of moisture being sufficient to absorb the rays. [See also next Abstract.] G. E. A.

294. *Effect of* N-*rays on the Eye.* **R. Blondlot.** (Comptes Rendus, 137. pp. 831–833, Nov. 23, 1903.)—When studying the storing-up of *n*-rays by different bodies, the author observed an unexpected phenomenon. Whilst his eyes were fixed on a small band of paper feebly illuminated and about 1 m. distant, a brick which had been exposed to the sun was brought up towards his eyes; at once the band of paper appeared brighter; when the brick was removed the paper appeared darker. The same effect was produced when the brick was enclosed in a box covered with black paper and brought near the eyes of the observer. The face of a clock in a darkened room which was barely visible, and appeared as a grey patch to the observer, became clearly outlined and the hands visible when the brick previously exposed to sunshine was brought up towards the eyes. While water stops the *n*-rays, a dilute solution of salt allows them to pass, and the small amount of salt in the humours of the eye appears to be sufficient to render it transparent to the *n*-rays. An ox eye was found to allow the rays to pass freely, and to store them up, becoming itself active after insolation. Similar results were obtained when the *n*-rays reaching the eye came from a Nernst lamp. Hyposulphite of soda, solid or in solution, was found to be a powerful accumulator of the *n*-rays. [See also preceding Abstract.] J. J. S.

295. *Radio-activity.* **H. S. Allen.** (Engineering, 76. pp. 781–783, Dec. 4, 1903. Paper read before the Royal Philosophical Society of Glasgow, Nov. 18, 1903.)—A summary is given of the properties of radium and other radio-active substances. The author with Blythswood has made some tests of the water obtained from the hot mineral springs in Bath. The rate of leak produced by ionisation due to the gas obtained from the Bath water was observed. This rate of leak was found to increase gradually to a maximum value after the introduction of the gas into the testing vessel, the maximum being reached in an hour, after which the rate of leak diminished. Similar effects were observed with gas obtained from the waters of Buxton. There thus appears to be some radio-active substance present in these deep-level waters, the behaviour of the gas being similar to that of the radium emanation. In the case of the ionisation current due to radium emanation, the maximum is reached, according to Rutherford and Soddy, after five or six hours. J. J. S.

296. *Analogies between Radio-activity and the Behaviour of Ozone.* **F. Richarz** and **R. Schenck.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 52. pp. 1102–1106, Dec. 10, 1903.)—Freshly prepared ozone, and ozone that has been decomposed by deozonisers, have the power of causing condensation in a steam-jet; this effect is produced in the absence of dust, and, in accordance with modern theories, must indicate that the ozone "ionises" the air. Such "ionisation" always renders the gas conducting, and this effect has been detected by the author and Uhrig (Dissertation, Marburg, 1903) in several cases of chemical action, including the case of ozone. The author and Gunckel have shown that this effect is very strong in ozone that has just been decomposed by platinum, and further that the platinum, when introduced into pure, dry, non-conducting oxygen, renders the gas conducting; it is therefore clear that, according to the current phraseology, the ozone is *radio-active* and the platinum exhibits *induced radio-activity.* The production and decomposition of ozone and of hydrogen peroxide are constantly occurring in the atmosphere, and this is regarded as a sufficient explanation of the slight conductivity normally observed in atmospheric air. The action of radio-active substances on a photographic plate finds an analogy in the case of ozone, experiments on this point having been made by the author and Braun, whilst van Aubel has shown that ozonised oxygen increases the

conductivity of selenium cells. Freshly prepared ozone also causes hexagonal zinc blende to fluoresce brightly, though barium platinicyanide and zinc oxide do not fluoresce; the blende is specially sensitive to massive ions such as the *a*-rays of radium and the canal-rays of the vacuum tube, and its fluorescence indicates that these are produced during ozonisation. The fluorescence continues during twenty-four hours if the blende is left in a flask containing ozone, but after forty-eight hours the fluorescence disappears together with the odour of ozone. It is possible that the fluorescence of zinc blende under the influence of radium salts is merely a secondary effect produced by ozone. T. M. L.

297. *Artificial Fluorescence of Living Tissues.* **W. J. Morton.** (Röntgen Ray, Archives, 8. p. 103, Nov., 1903.)—A large dose of quinine is administered an hour before treatment with the Röntgen rays with the object of producing an artificial fluorescence within the body. The author believes that this method has conduced very greatly towards success. H. W. P. Y.

298. *Action of Radium on Iodoform.* **W. B. Hardy** and **Miss Willcock.** (Röntgen Ray Archives, 8. p. 100, Nov., 1903.)—The action of radium on solutions of iodoform in chloroform is due to the β and γ rays. The action of light on the solution is due to the ordinary light waves. Such a solution in an ordinary test-tube is changed to a deep purple in 12 minutes by resting the point of the tube upon a mica plate covering 5 mg. of radium bromide. Radium rays, however, are much less active towards the solution than daylight. J. J. S.

299. *Radium in the Treatment of Cancer.* **M. A. Cleaves.** (Röntgen Ray, Archives, 8. p. 105, Nov., 1903.)—In the treatment of cancer the purpose would be best met by a full dose, in order to act destructively upon the foci of disease. Tubes of radium can be placed within accessible mucous cavities, and might be easily introduced into the œsophagus or stomach. In breast cancer a puncture could be made with the electro-cautery, in order to secure a bloodless opening, and the tube carried directly within the malignant growth. H. W. P. Y.

300. *Action of Radium Rays on Living Tissues.* **G. Bohn.** (Comptes Rendus, 137. pp. 883–885, Nov. 23, 1903.)—The action of radium rays on the integuments (worms, amphibians, man) is multiple: firstly, they act on the peripheral nerves, causing a kind of anæsthesia, which may be succeeded by fatigue or paralysis of the organs of external function, often followed by death; in vertebrates vaso-motor troubles are especially produced; secondly, they modify permanently the epithelial cells and consequently the growth of epitheliums; thirdly, they influence pigmentation. H. W. P. Y.

301. *Action of Radium on the different Tissues.* **J. Danysz.** (Comptes Rendus, 137. pp. 1296–1298, Dec. 28, 1903.)—The gravity of the lesions increases with the purity of the radium and with the time of exposure. Microscopical examination of the lesions produced in the brain or spinal cord in cases in which paralysis and rapid death occurred, showed that they are chiefly of vascular origin. The capillaries are ruptured and the nerve substance is stained with blood. The nerve cells presented no appreciable change. In cases in which death occurred in ten to twelve days, there is paralysis or cachexia and softening of the skin without appreciable con-

gestion. Radium has therefore evidently a direct action on the epithelial and nervous cells. Young cells are more susceptible than older ones. This fact explains to some extent the action of radium on neoplasms which can be attacked and profoundly modified through the skin and a layer of muscle, without the latter being affected. A hæmolytic serum from a dog completely lost its hæmolytic properties after three days' contact with a tube of radium salts, whilst the activity of trypsin was appreciably increased by fourteen hours' exposure. The action on diphtheric toxin was negative, even after prolonged exposure. H. W. P. Y.

302. *Physical and Therapeutic Properties of Radium.* **Jumon.** (Archives d'Él. Médicale, 11. pp. 755–760, Dec., 1903.)—The author first enumerates and describes the physical properties of radium and its salts. As regards its therapeutic use, there are two methods: The first is by short séances; the second by prolonged applications with the object of producing ulceration. The earliest phenomenon noticed is redness of the skin over the area treated, which appears after five or six days. A more intense reaction produces slight swelling or a definite induration, and at the end of a variable time desquamation of the skin. A still more intense reaction is accompanied by exudation of serum which dries and forms small yellow scabs. These fall off and leave shallow ulcers which have little tendency to granulate and heal very slowly. Very rarely, the ulceration extends below the dermis, and is then extremely painful. In the treatment of lupus, if the application be not sufficiently prolonged, cicatrisation is rapidly produced, but the disease tends to recur. Longer applications produce a cure which seems to be permanent. The resulting scar is white (often surrounded by pigmentition), supple, and free from cheloid, and the subjacent tissues are not indurated.

H. W. P. Y.

303. *Action of Radium, Röntgen Rays, and Ultra-violet Rays on Minerals and Gems.* **G. F. Kunz** and **C. Baskerville.** (Science, 18. pp. 769–783, Dec. 18, 1903.)—The gems of two large American collections are subjected to the action of the above radiations, and the behaviour, whether fluorescence or phosphorescence, is noted. Radium of activity ranging from 300,000 to 100 was employed. The three most responsive minerals to all three forms of activity were willemite, kunzite, and certain diamonds. Willemite from Franklin, N.J., was both fluorescent and phosphorescent. The effect on the various classes of minerals is described in detail, and a classification is suggested. G. E. A.

REFERENCES.

304. *Theoretical Optics.* **R. T. Glazebrook.** (Phil. Mag. 5. pp. 537–543, May, 1903. Communicated by the Physical Society, being part of the Presidential Address delivered Feb. 13, 1903.)—The author briefly surveys the development of optical theory, more particularly in relation to the work of Stokes. G. W. DE T.

305. *Stereo-photogrammetry in Topographic Work.* **C. Pulfrich.** (Zeitschr. Instrumentenk. 23. pp. 317–334, Nov., 1903. Communication from the Optical Workshops of Carl Zeiss.)—The author gives practical details [see also Abstract No. 1384 (1903)]. A. D.

306. *Radiation and Illumination.* (Engineering, 76. pp. 686–690, Nov. 20, and pp. 751–752, Dec. 4, 1903.)—These papers give a valuable summary of the more important investigations of the laws and nature of radiation with respect to their bearing on the question of illumination. G. W. DE T.

307. *Sensitiveness of the Eye.* **S. Durand.** (Comptes Rendus, 137. pp. 1280–1282, Dec. 28, 1903.)—The author describes a means of measuring the least amount of light visible in impaired vision. For short impressions, the duration of the perception is proportional to the luminous intensity. A. D.

308. *Rotatory Polarisation in Absorbent Substances.* **F. J. Bates.** (Ann. d. Physik, 12. 5. pp. 1080–1090, Nov., 1903. Lincoln University, Nebraska, May, 1903.) —A full discussion of the apparent errors ("false rotation") introduced in measurement, by various methods, of rotation in absorbent substances, through the unequal absorptions of different parts of the spectrum. A. D.

309. *Crystallographic-optical Measurements.* **V. v. Lang.** (Akad. Wiss. Wien, Sitz. Ber. 111. 2a. pp. 1161–1211, Oct. and Nov., 1902.)—Crystallographic measurements are given for a large number of inorganic and organic substances. T. H. P.

310. *Optical Activity of Nucleo-Proteids.* **A. Gamgee** and **W. Jones.** (Roy. Soc., Proc. 71. pp. 385–397, April 7, 1903.)—Measurements of the optical rotations of six nucleo-proteids prepared from various glands in a pure condition give numbers for $[\alpha]$ D varying from 37·58 to 97·9°. T. H. P.

311. *Structure of Spectra.* **C. Fabry.** (Chem. News, 87. pp. 207–209, May 1; 218–220, May 8; and pp. 234–237, May 15, 1903. Revue Genérale des Sciences, 14. No. 5, March 15, 1903.)—A short account of the present state of our knowledge of spectral series. E. C. C. B.

312. *Relation between the Absorption Spectra and the Chemical Structure of Corydaline, Berberine, and other Alkaloids.* **J. J. Dobbie** and **A. Lauder.** (Chem. Soc., Journ. 83. and 84. pp. 605–625, May, 1903.)—An account of the chemistry of the above and several other analogous alkaloids, and the connection between their absorption spectra and constitution; complete diagrams of the absorption curves are given. E. C. C. B.

313. *Absorption Spectra of Laudanine and Laudanosine in Relation to their Constitution.* **J. J. Dobbie** and **A. Lauder.** (Chem. Soc., Journ. 83. and 84. pp. 626–628, May, 1903.)—These two alkaloids are known to be homologous in their chemical constitution, and this is further emphasised by the very close similarity between their absorption spectra. The spectra also show that they are closely related to corydaline and tetrahydropapaverine. [See also preceding Abstract.] E. C. C. B.

314. *Photographic Activity of a Body Treated with Ozone.* **O. Dony-Hénault.** (Phys. Zeitschr. 4. pp. 416–418, April 15, 1903. Solvay Institute Laboratory, Brussels.) —This activity is traced to the production of H_2O_2 by ozone acting upon grease-films, as also by the action of moisture upon metallic aluminium. It is doubtful whether the H_2O_2 acts directly or by radiations of its own. A. D.

315. *Radio-activity and Allied Phenomena.* **W. J. Hammer.** (Amer. Inst. Elect. Engin., Trans. 20. pp. 541–612, May, 1903.) G. W. de T.

316. *Effects Produced by Radiations.* **J. H. Gardiner.** (Röntgen Ray, Archives, 7. pp. 126–133, May, 1903.)—A short description of the various known forms of radiation. Spectro-photographs are given of the light from the ultra-violet lamps now in use in various London hospitals for the Finsen treatment of lupus. Another series of spectro-photographs shows the effect of different materials in absorbing ultra-violet rays. G. E. A.

HEAT.

317. *Electric Thermostat.* **H. Darwin.** (Electrician, 52. p. 256; Discussion, p. 256, Dec. 4, 1903. Paper read before the Physical Society, Nov. 27, 1903.)—The thermostat consists of an oil-bath containing two heating coils, through which electric currents are passed, one permanent and the other intermittent. These currents are automatically controlled by means of a Wheatstone bridge, and keep the temperature of the oil-bath constant. A long horizontal boom, attached to the suspended coil of a galvanometer, governs a "hit or miss" arm, which is periodically raised by a rotating cam, and regulates the passage of the intermittent current. The cam is driven by a worm-gear, and any suitable motor. The permanent current is adjusted by cutting out resistance coils in series with the heating coil, and the oil is stirred by a fan. In the *discussion*, **A. P. Trotter** considered that the value of thermostats would increase with the perfection of thermometers, and that such complicated apparatus as the one shown could only be of use where the greatest accuracy was obtainable with ordinary devices.
W. H. S.

318. *Expansion of Amorphous Quartz.* **K. Scheel.** (Deutsch. Phys. Gesell., Verh. 5. 5. pp. 119–123, March 15, 1903. Communicated by the Physikalisch-Technische Reichsanstalt.)—The recent measurements of the expansion of amorphous quartz by Holborn and Henning at temperatures up to 1,000° C. [see Abstract No. 1020 (1903)] have shown that within the limits of experimental error the expansion is a straight line function of the temperature, the coefficient being $0{\cdot}54 \times 10^{-6}$ per degree Centigrade and per unit length. The present paper contains a more minute investigation of the expansion between 0° and 100° C. Fizeau's method was employed, the standard body being a piece of crystalline quartz. [See Abstract No. 640 (1903).] The results of the experiments are expressed in the formula, $l_t = l_0(1 + 0{\cdot}322 \times 10^{-6} \times t + 0{\cdot}00147 \times 10^{-6} \times t^2)$. The results, contrary to what might be expected from those of Holborn over much greater range, show a considerable curvature in the line, the curvature coefficient being of the same order as is observed in metals, and numerically almost equal to that of platinum, while the linear coefficient is little more than 1/30 of the linear coefficient for platinum.
J. B. H.

319. *Temperature of Flames.* **C. Féry.** (Comptes Rendus, 137. pp. 909–912, Nov. 30, 1903.)—Flame temperatures are determined in the following manner: The image of the filament of an incandescent lamp is thrown by a lens on to the slit of a spectroscope. The rays from the filament pass through the flame to be studied, which contains sodium vapour. When the filament is raised in temperature the D-line is ultimately reversed; just at the point of passing from bright to dark it disappears; at this point the flame has the same temperature as the filament. The temperature of the filament is measured by an improved form of optical pyrometer (le Chatelier pattern).
W. S.

320. *Variation in the Rate of Cooling of Bodies Heated and Electrified under the Influence of Radium.* **N. Georgiewski.** (Jurn. Russk. Fisik.

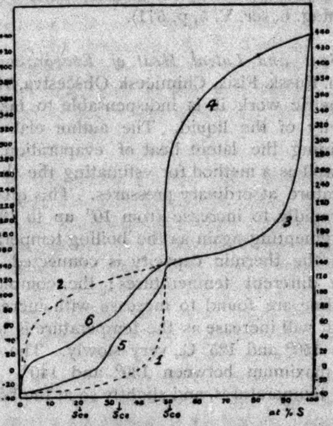
Chimičesk. Obščestva, 35. No. 6b. pp. 553–564, 1903.)—As a result of an experimental investigation of the influence of radium on the rate of cooling of a body placed in a gaseous medium, the author arrives at the following conclusion: (1) The rate of cooling of non-electrified heated bodies in the various gases is not modified under the influence of radium. (2) The rate of cooling of heated bodies placed in one of the gases examined (hydrogen, coal gas, air, and carbonic acid) on being exposed to the action of radium is augmented in the case of the heated bodies being electrified. The rate of cooling in this case will augment not only under the simultaneous influence of the α-, β-, and γ-rays of radium, but as well under the exclusive action of β- and γ-rays. (3) The increase in the rate of cooling of a heated body is greater if the body is negatively charged. (4) The relations existing between the increase in the thermic conductivity and the potential of a charged and heated body may be represented by means of curves analogous to those by which Townsend expresses the connection between $\alpha : p$ and $X : p$ for the same gases (Phil. Mag. 6. ser. V. 5, p. 571). A. G.

321. *Specific Heat and Latent Heat of Evaporation of Aniline.* **W. Kurbatoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 34. No. 8a. pp. 766–788, 1902.)—In calorimetric work it is indispensable to take into account the thermic conductivity of the liquid. The author elaborates a method for accurately determining the latent heat of evaporation, both at high and low pressures, as well as a method for estimating the thermic capacity from the boiling temperature at ordinary pressures. This quantity, in the case of aniline, is found rapidly to increase from 10° up to 137°, passing through a minimum and augmenting again as the boiling temperature is approached. This behaviour of the thermic capacity is connected with the degree of association at the different temperatures; the complete latent heats of evaporation of aniline are found to increase with increasing temperatures. The true latent heat will increase as the temperature is lowered, first rapidly and then, between 150° and 125° C., very slowly. The density of saturated vapours shows a maximum between 130° and 140°. Aniline is strongly associated at lower temperatures, and slightly so at the boiling temperature. A. G.

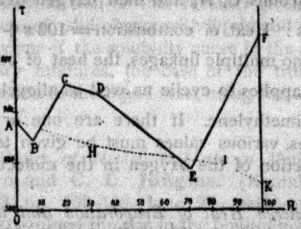
322. *Shapes of Melting-point Curves in Binary Mixtures of Isomorphous Substances.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. p. 169–187, June 27, 1903.)—It has frequently been stated that the existence of so-called eutectic points in melting curves hardly agrees with the hypothesis of a complete isomorphism of the two solid components and their mixtures. An interruption of the solid mixture series, it was thought, should be possible only in the case of isodimorphic substances, whereas for isomorphous substances the mixture series would of necessity be uninterrupted. The author shows that an interruption of the series of mixtures may occur also in the case of perfectly isomorphous substances, as, especially in the solid phase, unstable states may occur, it being possible, in all the possible cases, to draw the melting curve continuously through the eutectic point, when only the stable states will be susceptible of realisation, the series of mixture only being interrupted in practice. A. G.

323. *Boiling-point Curves of the System Sulphur + Chlorine.* **H. W. Bakhuis Roozeboom.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 11–13, May 30, 1903.)—Binary systems have frequently been investigated from the

point of view of the equilibria between the liquid and solid phases [see Abstract No. 512 (1908)], but hardly ever with regard to the equilibria between liquid and vapour. The author therefore endeavours to further illustrate the connection between vapour pressure and boiling curves by a series of instances with various kinds and amounts of complex molecules, so as to arrive at a better understanding of the special deformation shown by the curves, as compared with the simple cases where the binary system is made up only of two kinds of molecules. Such an instance is afforded by the system sulphur + chlorine, investigated by Aten. Liquid sulphur and liquid chlorine are miscible with one another in any proportions. In the case of no complex molecules being formed in these mixtures, two boiling curves of regular behaviour should be expected, diverging very much from one another in the middle part on account of the great distance between the boiling-points of the two components. Now a rather stable compound S_2Cl_2 is formed in these mixtures. As the dissociation of this compound in the gaseous state is known to be small, the connection corresponding with the composition SCl should be continuous, so as to give nearly coincident liquid and vapour curves in this point. This was actually found to be the case, as shown in the Fig., where the liquid curve is represented by 1, 3, and the vapour curve by 2, 4. The boiling curves 1 and 2 for mixtures, the composition of which is intermediate between Cl and SCl, are relative only to mixtures recently made from liquid S_2Cl_2 and liquid Cl_2, preserving at temperatures below zero their yellow colour for a long time, and exhibiting the boiling lines 1 and 2, whereas at higher temperatures the colour is found to become darker and finally blood-red, especially in the neighbourhood of the composition SCl_4, when the boiling-points are found to increase considerably, so as to give the line 5 for the definite boiling-point. At the same time the vapour curve 2 will be replaced by curve 6. A. G.



324. ***Fusibility of Mixtures of Bismuth Protosulphide and Silver Sulphide, and of Bismuth Protosulphide and Antimony Sulphide.*** **H. Pélabon.** (Comptes Rendus, 147. pp. 920–922, Nov. 30, 1908.)—The author has determined the points of (incipient) solidification of mixtures of bismuth protosulphide and silver sulphide, and of bismuth protosulphide and antimony sulphide; and his results are represented graphically in the accompanying Figure, in which the ordinates represent temperatures and the abscissæ the percentage amount of silver sulphide or of antimony sulphide. The freezing-point curve of bismuth sulphide and silver sulphide consists of several branches—A, B, C, D, E, F—exhibiting two eutectic points and a maximum point, C. There is also a break in the curve at D, corresponding to a mixture Ag_2S, 2BiS. The different singular points have the following values: A, the melting-point of bismuth protosulphide at 685°; B, eutectic mixture of BiS and Ag_2S, 4BiS, at 648°; C, compound Ag_2S, 4BiS, at 750°; E, eutectic mixture with 72 per cent. of silver sulphide at 585°; and F, melting-point of silver sulphide at 845°.



In the case of bismuth protosulphide and antimony sulphide, the curve is simpler (A, H, I, K), and exhibits no eutectic point. There are two breaks in the curve H and I corresponding respectively to the composition 31·66 per cent. and 84·85 per cent. antimony sulphide, and the temperatures 632° and 591°. Point H corresponds to the composition 3BiS, Sb_2S_3, and I to BiS, $4Sb_2S_3$. The author considers one of them at least to be a definite compound.

A. F.

325. *Determination of the Heat of Combustion of some Alcohols of the Fatty Series and an Oxine.* **P. V. Zuboff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. 7a. pp. 815–824, 1903.)—Comparing the values found for the heats of combustion of compounds of the fatty series with the figures for the cyclic compounds of the same molecular weight as the former, the author concludes that the heats of combustion of the bodies of the fatty series, though little different from those of the corresponding cyclic compounds, are, nevertheless, apparently somewhat higher than the latter. Hence it is inferred that compounds with open chains possess a somewhat higher store of energy than the corresponding body consisting of a closed group of atoms.

A. G.

326. *Heat of Vaporisation of Oxygen, Nitrogen, and Air.* **J. S. Shearer.** (Phys. Rev. 17. pp. 469–475, Dec., 1903.)—In order to verify the results obtained from the vaporisation of air, it seemed desirable to determine the constants for pure oxygen and nitrogen. The apparatus previously described [see Abstract No. 316 (1903)] was used with some modification. In this, a coil heated by an electric current is immersed in the liquid gas. Six determinations were made for oxygen, and the mean was 61 calories per gram, the calculated value was 60·8. The results for nitrogen were more concordant: the mean of several determinations was 49·83, the greatest variation being

0·11; the calculated value was 49·25. For liquefied air the gas given off was measured by a meter which was read at intervals, and the gas analysed till the whole had been vaporised; hence the composition of the liquid remaining behind could be determined. A comparison between the observed results and those computed from the values found for oxygen and nitrogen was made, but the agreement was not very exact. F. S.

327. *New Method for Calculating Heats of Combustion, and some of its Consequences.* **P. Lemoult.** (Comptes Rendus, 137. pp. 979–982, Dec. 7, 1903.)—For hydrocarbons $C_x H_y$ and their oxygen derivatives $C_x H_y O_p$ the formula proposed is: Heat of combustion $= 102x + \frac{55}{2}y - Ep\phi + K$. If $p = 0$ and there are no multiple linkages, the heat of combustion is given by $102x + \frac{55}{2}y$. This applies to cyclic as well as alicyclic hydrocarbons, with the exception of trimethylene. If there are one or more "ethylene" or "acetylene" linkages, various values must be given to K. The value of ϕ depends on the function of the oxygen in the molecule. F. G. D.

328. *Relation between Heat of Evaporation and the Critical Constants.* **A. J. Batschinski.** (Zeitschr. Phys. Chem. 43. pp. 369–371, April 9, 1903.)—As an improvement on a formula proposed by Bakker, the author deduces the formula $Mr = 2T + 6{\cdot}5\frac{T_k^2}{T}\cdot\frac{1}{\frac{v}{v_k}+0{\cdot}44}$ where $M =$ mol. wt., $r =$ heat of evaporation per grm., $T_k =$ crit. temp., $v_k =$ crit. vol. This equation only holds for non-associated liquids. Putting $T =$ boiling-point, and writing then $T/T_k = 2/3$ $v/v_k = 0{\cdot}37$, we get Trouton's formula, $Mr/T = 20{\cdot}1$. Figures given by Ramsay and Young for the r of diethylether agree well with those calculated by the above formula. F. G. D.

329. *Critical Temperature of Solutions.* **M. M. Centnerszwer.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. pp. 742–794, 1903.)—An experimental investigation of the influence of only very slightly volatile substances on the critical temperature of the solvent gave the following results: (1) These substances materially augment the critical temperature of the solvent. (2) This increase is proportional to the concentration of the dissolved substance. (3) The "molecular" increase of the critical temperature does not depend on the nature of the *dissolved* body. (4) The "molecular" rise is higher in that solvent which possesses a higher molecular weight. (5) The critical temperature of the solution is the lower, as the tube is filled more completely, this being a difference between the behaviour of solutions and pure substances. A. G.

330. *Determination of the Critical Temperature.* **K. v. Wesendonck.** (Deutsch. Phys. Gesell., Verh. 5. 13. pp. 238–240, July 15, 1903.)—The author recalls some of his experiments on the determination of the critical temperature of carbon dioxide in a Natterer tube, in which he found that on heating to above 30·95°, the liquid became dissipated in the form of mist, but this mist persisted until the temperature was raised to above 31·7°. The author then refers to the opinion expressed by Ramsay that so long as the mist persists, the critical temperature is not yet reached, and adds that if this is accepted, the critical temperature of carbon dioxide must be taken as higher than that usually given. This state of mist formation which intervenes between the liquid and gaseous states may perhaps be a state of false equilibrium and will disappear only on infinitely prolonged heating—in practice, therefore, it will always appear. The study of these phenomena with carefully purified substances is recommended. A. F.

331. *Solubility Curve in the Critical Temperature Region of Binary Mixtures.* **A. Smits.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 335–345, Sept. 26, 1903.)—Investigations of the critical temperature of binary mixtures on van der Waals' theory, as well as that recently given by Bakhuis Roozeboom, of the equilibrium of solid phases with liquid and vapour, suggested an inquiry into the behaviour of the solubility curve in the region of the critical temperatures of binary mixtures, the case of the true components being miscible in any proportion in the liquid state being the only one considered. A. G.

332. *State of Hydrates of Nickel Sulphate in Methyl-alcoholic Solution.* **C. A. L. de Bruyn** and **C. L. Jungius.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 153–156, June 27, 1903.)—One of the authors had (ten years ago) determined the rise in the boiling-points of some hydrates of nickel sulphate dissolved in absolute methyl alcohol, when the provisional conclusion was drawn that a certain portion of the water, *i.e.*, about 3 molecules, is bound to the $NiSO_4$. As, however, in calculating the results of these experiments, some factors, such as, for instance, the pressure of an electrolytical dissociation, even in alcoholic solution, and the influence of a dissolved volatile substance on the rise of the boiling-points, were not taken into account, the authors have resumed their former experiments. It is shown that water, on being added to methyl alcohol will, from the very beginning, produce a rise in the boiling-point, no minimum boiling-point being observed as in the case of ethyl alcohol and water. The electrolytic dissociation is shown to be very low, though its existence will warrant the conclusion that a certain amount of water is bound to the nickel sulphate. Hydrates of nickel sulphate in 1 per cent. methyl-alcohol solution are further found to lose their water of crystallisation to within 1 molecule. A. G.

333. *The System Bromine + Iodine.* **H. W. Bakhuis Roozeboom.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 361–363, Sept. 26, 1903.) —The elements chlorine and iodine, as is known, will unite to form chemical compounds which have been accurately investigated by Stortenbeker. The system bromine + iodine, on the other hand, had not so far been examined. In this paper, the two boiling curves determined at a pressure of 1 atmosphere are given, corresponding with the boiling-points of the series of liquid mixtures and the vapours yielded by the liquids respectively. It is shown that these lines, though continuous, will appreciably approach one other between 50 and 60 per cent. The singular form of the boiling lines points to the existence of associated molecules of the two elements, it being so far impossible to ascertain whether these will correspond with the formula BrI. The author thinks it possible that this system is an instance of the case of a compound being miscible with its two components. He purposes ascertaining this by a determination of the density, &c. A. G.

334. *Measurement of the Pressure Coefficient of Oxygen at Constant Volume and Different Initial Pressures.* **W. Makower** and **H. R. Noble.** (Roy.

Soc., Proc. 72. pp. 379–385, Nov. 21, 1903.)—Using the method of Travers and Jaquerod, the authors obtained the following values of the coefficient, viz., 0·00367, 0·0036697, 0·0036745, 0·0036726, 0·0036744 at the initial pressures 369·1, 378·6, 695·6, 698·3, 707·8 mm. respectively. On plotting the values of the coefficient against the initial pressures, the value at zero initial pressure is found on linear extrapolation to lie between 0·003664 and 0·003665—a value which is higher than that similarly obtained for nitrogen from Chappuis' determinations and likewise higher than the pressure coefficient of hydrogen, 0·0036625, as obtained by Travers and Jaquerod. With the above value for the coefficient of oxygen we may, by Callendar's method [see Abstract No. 1205 (1903)], find the equivalent of 0° C. on the thermodynamic scale; it works out as 273°·09.

D. H. J.

335. *Energy Alterations with Changes of Concentration in Concentrated Solutions.* **F. Dolezalek.** (Deutsch. Phys. Gesell., Verh. 5. 4. pp. 90–100, Feb. 28, 1903.)—Whilst much attention has been paid to the energy-content of dilute solutions which obey the simple gas laws, little has been done in the case of more concentrated solutions, and it has hitherto been possible to make calculations only by means of an integration of the vapour pressures over a wide range of concentrations. The experiments of Dieterici have shown, however, that if the composition of the solution be expressed by a formula such as νNaOH + H_2O, then a linear relationship exists between ν and the vapour pressure p for concentrations above $\nu = 0{\cdot}1$, so that $\frac{d\,lg\,p}{d\nu} = \text{const.} = a$, and the transportation of 1 mol. of water from a solution of concentration ν_1 to one of concentration ν_2 involves the expenditure of work approximately represented by the formula $A = ak\mathrm{T}(\nu_1 - \nu_2)$, a function almost as simple as those which apply in the case of dilute solutions. The linear relationship only holds good if $\nu > 0{\cdot}1$, *i.e.*, if the solution is stronger than about 5N. The constant a is a very important physical constant for the solution, and the following table of values is given :—

H_2SO_4	8·4	KI	2·5	$NaNO_3$	1·6
HCl	7·9	KBr	1·8	LiBr	5·8
H_3PO_4	3·0	KCl	1·8	LiCl	4·6
NaOH	7·4	KNO_3	1·2	NH_4Br	2·1
KOH	3·9	NaI	4·1	NH_4Cl	1·7
K_2CO_3	7·1	NaBr	3·5	$ZnCl_2$	8·4
KF	4·8	NaCl	2·8	$C_3H_8O_3$	1·01

The same constant may be used to calculate the vapour pressure of the solute from the formula $\log_{10}\pi = k - a\log_{10}\nu$, which gives a satisfactory agreement in the case of aqueous hydrochloric acid above 5N, and can also be used to calculate the effect of changes of concentration on the e.m.f. of a battery.

T. M. L.

336. *Concerning the Phase-Law.* **R. Wegscheider.** (Zeitschr. Phys. Chem. 43. pp. 93–108, March 13, 1903.)—A discussion of the phase-law in relation to the occurrence of cases where a greater number of phases can coexist than might be predicted by the ordinary form of the law. It is pointed out that the exception is only apparent, since the phase-law regards as identical all phases which are *thermodynamically identical, i.e.*, whose specific volume and specific total energy are the same functions of temperature, pressure, and composition. The author proposes to include such cases

by the introduction of *non-thermodynamical variables*, such as, *e.g.*, specific rotatory power. The whole discussion can only be regarded as marking a point in the author's study of the phase-law, since it deals with explanations which have long been familiar to those who have studied the same subject.
F. G. D.

337. *On the Concept of Independent Constituents.* **R. Wegscheider.** (Zeitschr. Phys. Chem. 43. pp. 89–92, March 13, 1903.)—The author considers previous definitions as unsatisfactory, and proposes the following: "Independent constituents are those substances which are necessary and sufficient to build up, under the given experimental conditions, (1) the equilibrium-states of the system, and (2) in an equilibrium-state to express the composition of each single phase."
F. G. D.

338. *On the Proof of Gibbs' Phase-Law.* **W. Nernst.** (Zeitschr. Phys. Chem. 43. pp. 113–114, March 13, 1903.)—A note on Wegscheider's paper [see Abstract No. 336 (1904)]. The author sees no reason to change the treatment of the phase-law adopted in his well-known treatise. He agrees with C. H. Wind, however, that the proof referred to will require to be more precisely formulated—a matter which will be remedied in the new edition.
F. G. D.

339. *Equilibria in System, Succinonitrile—Silver Nitrate—Water.* **W. Middelberg.** (Zeitschr. Phys. Chem. 43. pp. 305–353, April 9, 1903. Extract from Inaugural Dissertation.)—Graphical thermodynamics. Study of a ternary system exhibiting two liquid phases. Binary compounds discovered ($A = AgNO_3$, $B = C_2H_4(CN)_2$):—4A . B (already known), 2A . B, A . B. Ternary compounds discovered (W = water):—A . 2B . W, 4(A . 2B) . W. The composition of the latter is doubtful.
F. G. D.

340. *Equilibria between CO, CO_2, and the Oxides of Iron.* **E. Baur** and **A. Glaessner.** (Zeitschr. Phys. Chem. 43. pp. 354–368, April 9, 1903. From the Lab. für inorgan. chem. der Technische Hochschule, München.)—An important paper for the theory and practice of blast-furnace working. At atmospheric pressure CO and CO_2 can coexist with C, FeO, and Fe_3O_4 at *circa* 647° C.; with C, FeO, and Fe at *circa* 685°. Between these limits C can coexist with FeO; above, with Fe; below, with Fe_3O_4. The reduction of FeO to Fe is effected by the smallest ratio CO/CO_2 at 680°. A higher ratio is required at higher and lower temperatures. Fe_3O_4 requires the highest CO/CO_2 ratio for its reduction at 490°.
F. G. D.

341. *Continuity of the Liquid and Gaseous States and the different Solid Conditions.* **H. Kamerlingh Onnes** and **H. Happel.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 223–247, June 27, 1903.)—This paper is intended to give the form of the Gibbs' surface, as far as known by experimental data, for substances occurring also in the solid state, completing these portions with the vapour and liquid regions according to van der Waals' views, both being connected so that the isothermals of the Gibbs' surface show as small departures as possible from van der Waals' invariable isothermal, when the behaviour of the isothermals in the ηv projection becomes as simple as possible.
A. G.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

342. *Generalisation of the Fundamental Property of the Potential.* **A. de Saint-Germain.** (Comptes Rendus, 137. pp. 736–738, Nov. 9, 1903.)—As is well known, for the Newtonian law of attraction the potential of a uniform sphere of finite density at any point within its volume is constant, and that of an infinitely small sphere is zero, being of the form—

$$\lambda\int_0^r \frac{4\pi r^2 dr}{r} = \lambda\int_0^r 4\pi r dr = 0$$

as r diminishes indefinitely. The writer proposes to extend the law to the case where, instead of the Newtonian law $\frac{1}{r^2}$, we have $\frac{1}{r^n}$ and $n<4$. He says if ρ be the density at a point A within the mass, then at distance u the density is $\rho + au$, where a depends on the direction of u. He considers a sphere of radius ϵ having A for centre. The attraction due to the sphere in direction x at A is—

$$\lambda\int_0^{2\pi}\int_0^{\pi}\int_0^{\epsilon} \frac{\rho \sin\theta \cos\theta du d\theta d\phi}{u^{n-2}} + \lambda\int_0^{2\pi}\int_0^{\pi}\int_0^{\epsilon} \frac{a \cos\theta \sin\theta du d\theta d\phi}{u^{n-3}}.$$

The first integral represents the attraction in x due to a uniform sphere of density ρ, and is zero. The second integral can be put in the form—

$$\iiint \frac{a_1 \sin\theta du d\theta d\phi}{u^{n-3}}$$

if a_1 is the mean value of $a\cos\theta$. This is equal to $\frac{2\pi\lambda a_1}{4-r}\epsilon^{4-n}$, and vanishes with ϵ if $n<4$. The property is then easily deduced. S. H. B.

343. *Bending of Electric Waves.* **H. M. Macdonald.** (Roy. Soc., Proc. 71. pp. 251–258, March, 1903.)—The author investigates the case of a simple Hertzian oscillator placed outside a perfectly conducting sphere. Taking a as the radius of the sphere and O its centre, the oscillator is assumed to be placed with its axis along a radius of the sphere, and at a distance $OC = r_1$ from the centre. The lines of magnetic force are then circles having their centres on OC, and lying in planes perpendicular to OC. If γ is the magnetic force at a point P, whose distance from OC is ρ, then, if z is the distance of P from a plane of reference perpendicular to OC, and $2\pi/\kappa$ is the wave-length of the oscillations, $\gamma\rho$ will satisfy the equation—

$$\frac{\partial^2}{\partial\rho^2}(\gamma\rho) - \frac{1}{\rho}\frac{\partial}{\partial\rho}(\gamma\rho) + \frac{\partial^2}{\partial z^2}(\gamma\rho) + \kappa^2\gamma\rho = 0.$$

After transformation to polar co-ordinates, the general solution is obtained in terms of Bessel functions, and zonal harmonics of integral order. The magnetic force is then calculated, and also the electric force for wave-lengths small in comparison with the radius of the sphere. Hence it is found that the condition for the formation of a distinct shadow near the surface of a perfectly conducting body of convex surface, when electric waves are incident upon it, is that there should be a line on that part of the surface inside the geometrical shadow along which the radius of curvature of the surface in the plane of incidence of the waves is small compared with the wave-length. The effect of imperfect conduction is to slightly diminish the electric force normal to the surface of a good conductor. For sea-water, the author states that, for the wave-lengths actually used, this correction is less than one part in a hundred millions. Taking the case of the earth, transmission being over the sea, it is found that, at a distance of somewhat over 3,000 miles, the amplitude of the electric force acting on the receiver is more than half the amplitude directly due to the oscillator at that distance, and the intensity nearly three-tenths. These results explain the fact that wireless-telegraph transmission is more effective over sea than over land. They also explain the fact observed by Jackson [see Abstract No. 811B (1903)] that intervening headlands may seriously interfere with wireless transmission, a fairly sharp ridge causing a distinct shadow, which may be sufficiently intense to make the effects inappreciable on the side removed from the transmitting station. G. W. DE T.

344. *Electromagnetic Mass of Electrons.* **H. Starke.** (Deutsch. Phys. Gesell., Verh. 5. 13. pp. 241–250, July 15, 1903.)—Working with the rapidly moving electrons from radium, Kaufmann has found that the ratio e/m decreases as the velocity increases, which is the result to be expected from the view of a mass purely electromagnetic in origin [see Abstract No. 457 (1903)]. The velocity attained in those experiments reached $2·8 \times 10^{10}$ cm./sec. The author here shows that a change in e/m can be observed for the kathode rays in a Braun tube. *Relative* velocities were calculated from the observed magnetic and electrostatic deflections of the rays. Table I. below gives a sample of the results obtained by experiment. Table II. gives the results of calculations according to Abraham's theory on the supposition of a purely electromagnetic mass. v is the velocity of the rays and V the velocity of light.

TABLE I.

v/V.	e/m.
0·17	1·88
0·19	1·87
0·22	1·86
0·29	1·83
0·33	1·81
0·37	1·79
0·38	1·78

TABLE II.

v/V.	e/m.
0·15	1·88
0·20	1·87
0·25	1·85
0·30	1·83
0·40	1·77

R. S. W.

345. *Influence of the Medium on the Induction of Currents.* **B. Weinberg.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 6b. pp. 565–568, 1903.)—The author first indicates the variation in the magnetic force and the magnetic induction (termed "magnetic polarisation" by Hertz) produced by a change in the infinite medium surrounding a system of magnets or conductors traversed by currents. As the case of an infinite medium is unrealisable, the author next considers what should be the form of a surface limiting the medium investigated, so that the variations in the magnetic force and polarisation are the same as for an infinite medium. As the direction of these vectors is invariable in the latter case, it is shown that the surface of the medium should coincide with lines of force and with equipotential surfaces. On this account the variations undergone by the magnetic force and polarisation in the field of the magnets and in the field of the current are further investigated in the case of the surface of the medium coinciding with lines of force or with equipotential surfaces. All the theoretical conclusions relative to the magnetic polarisation have been qualitatively confirmed, under variable conditions, by numerous experiments on induction currents in conductors surrounded alternatively by air and by iron filings. The conclusions arrived at in the first part of this paper are applied to a study of a possible variability of the coefficient l in Laplace's formula—

$$df = l\frac{\mathrm{imds} \,.\, \sin(ds \,.\, r)}{r^2}$$

in different media. Comparisons of the currents induced by a magnet in coils surrounded by air, water, vaseline, oil, and solutions of H_2SO_4 and Mn_2Cl_6 (made by a differential method) show this coefficient to be most probably invariable within 1/100000 and certainly within 1/30000 of its value.

A. G.

346. *Magnetic Properties of Circularly Moving Particles.* **J. J. Thomson.** (Phil. Mag. 6. pp. 673–693, Dec., 1903.)—The author investigates mathematically the magnetic properties of a system of negatively electrified particles situated at equal intervals round the circumference of a circle rotating uniformly in its own plane, determining the magnetic field produced, and the effect of an external magnetic field on the motion and periods of vibration. The author confirms the results obtained by a quite different method by Voigt. [See Abstract No. 1115 (1902).] G. W. de T.

347. *Influence of Deformation on Electrification.* **N. Hesehus.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. pp. 575–580, 1903.)—In former experiments, made in conjunction with N. Georgiewski [see Abstract No. 1087 (1902)], the author had shown in the first place that decreasing the surface density of a given body will render the latter more negative in regard to electrification. As, however, in nearly all the former experiments, the variation in surface density was produced either by heating or by polishing, the possibility of a chemical action complicating the phenomena was not wholly excluded. The author therefore undertook another series of experiments in which the variations in surface density were due to deformations of the body. The conclusions drawn are as follows: (1) Compressed glass will be electrified positively with respect to non-deformed glass. (2) Elongated pieces of rubber tubing are negatively electrified on being rubbed with non-elongated pieces of the same tubing. (3) A bent plate, being rubbed with a plane plate, is electrified positively on the concave side and negatively on the convex side, this effect being most striking in the case of ebonite and hardly noticeable with metals, especially with aluminium. This fact may be accounted for as follows: Two bodies in contact may be considered as

constituting a condenser, the electric energy of the surface unit of this condenser resulting from the variation in surface tension (α) due to the contact; therefore $ku^2/8\pi\varepsilon = \alpha$ or $u^2 = 8\pi\varepsilon\alpha/k$. The potential difference (u) should therefore be small for bodies of high dielectric constant k (metals). (4) Taking into account all that is known on the subject, the following general law may definitely be enunciated: When rubbing or bringing into contact two bodies of the same chemical nature, that body the surface of which is in the higher state of tension is found to be positively electrified. A. G.

348. *Electricity Dispersion in the Air.* **R. Börnstein.** (Deutsch. Phys. Gesell., Verh. 5. 22. pp. 404–414, Nov. 30, 1903.)—The author experiments near Berlin. In cellars he finds the electric conductivity only slightly greater than in the open air. Air drawn up from the sandy soil at a depth of 1 or 2 m. conducted about twenty times better than air in the houses. This effect might be due to an emanation from the underground water. Contact between the air and small volumes of water (wetting the glass vessels with water, bubbling the air through water, or shaking the air with water) had little influence, however; but when the air was kept in contact with large and renewed volumes of water (in pumps, or by injecting water), the conductivity of the air was distinctly increased. H. B.

DISCHARGE AND OSCILLATIONS.

349. *Action of Radium Rays on Sparking Distance.* **A. P. Grusintzew.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 34. No. 7b. pp. 337–367, 1902.)—The property of radio-active bodies of lowering the discharge potential or, in other words, augmenting the sparking distance, which they share with ultraviolet rays, has been observed by many experimenters, though no results of a systematic investigation are as yet available. Moreover, in all the investigations so far made only low potentials were used, 800 volts being the upper limit. It is inferred from the author's experiments that (1) the discharging influence of radium will diminish with the distance, and (2) the maximum lowering of the potential will be displaced towards shorter sparking distances, as the distance of the radium is increased. A. G.

350. *Movements in Rarefied Gas round a Wire put to an Inductor-Pole.* **J. Borgmann.** (Phys. Zeitschr. 4. pp. 401–403, April 15, 1903. Phys. Inst. Univ. St. Petersburg.)—The author in this article gives photographs of the luminescence of rarefied gas surrounding a metallic wire attached to a pole of an induction coil, of which the two poles are connected with a spark-gap. [See Abstracts Nos. 217 and 743 (1903).] Also photographs of the arrangement and movements of fine dust within the rarefied gas. A. D.

351. *Kathode Rays from Glowing Kathodes.* **A. Wehnelt.** (Deutsch. Phys. Gesell., Verh. 5. 14. pp. 255–258, July 30, 1903.)—Wiedemann has shown that a red-hot kathode emits kathode rays under a very small potential difference. The provisional results of experiments on these rays are here given. They may be briefly summarised as follows: (1) The magnetic deflection of the rays increases (*a*) at constant temperature with rising pressure, (*b*) at constant pressure with rising temperature. (2) The rays appear as a well-defined bundle when the kathode is red-hot and disappear when it

is white-hot. (3) With increase of temperature the kathode fall decreases from several hundreds to a few volts only. (4) The velocities found varied between 0·016 × 10^{10} and 0·107 × 10^{10} cm. per sec. (5) The ratio *e/m* ranged from 1·34 × 10^7 to 1·81 × 10^7. The rays excite a strong phosphorescence.
R. S. W.

352. *Electrodeless Discharge.* **B. Davis.** (Phys. Rev. 17. pp. 501–505, Dec., 1903. Abstract of a paper presented at the meeting of the American Physical Society, Oct. 31, 1903.)—The paper makes some important advances in our knowledge of the discharge, but is not easily abstracted. A summary of the results is as follows: (1) The volts per cm. required to produce the discharge depends on the nature of the gas. (2) There is a minimum potential for each gas. The minimum and the pressure at which it occurs depends on the frequency of oscillation. (3) The volts per cm. are independent of the frequency for pressures above the critical point. (4) The number of volts through which an ion must fall freely in order to produce new ions by collision is found. It equals 2·4 in air; 1·66 in helium. (5) The ratio of the mean free path of an ion to that of a molecule is obtained, and equals four approximately. [See also Abstract No. 1223 (1903).] R. S. W.

353. *Electrical Discharge from a Point to a Plane.* **N. R. Campbell.** (Phil. Mag. 6. pp. 618–627, Nov., 1903.)—The object of the experiments is to elucidate the mechanism whereby the current is transferred between the electrodes. C. T. R. Wilson's fog apparatus is the means used. The conclusions arrived at are: (1) If the discharge induces no chemical reaction, the current is carried entirely by ions and by no larger particles of the electrodes or gas. (2) No discharge from a point can be obtained in which positive ions exist unaccompanied by negative ions. R. S. W.

354. *Potential Gradient in Conducting Gases, especially Flames.* **H. Starke.** (Deutsch. Phys. Gesell., Verh. 5. 21. pp. 364–376, Nov. 15, 1903.)—The following are the author's conclusions from his own experiments and those of other physicists. The potential fall has a minimum between two electrodes when the contained gas possesses volume ionisation. It is assumed that no new ions are formed by collisions. There is no minimum when surface ionisation is the sole source of the conduction. The temperature, &c., of the anode is altogether without influence when both electrodes are in the flame. Unless the kathode glows, the conduction in flames arises entirely from volume ionisation. Surface ionisation is present near a glowing kathode only. [See also Abstract No. 188 (1904).]
R. S. W.

355. *Oscillatory Discharges.* **A. Battelli** and **L. Magri.** (Phil. Mag. 5. pp. 1–34, Jan., 1903.)—The authors point out that, though experiments have been made to test Thomson's theory of condenser discharges, no systematic investigation has yet been made of all the elements capable of modifying the period of oscillation. Their research was undertaken with a view of effecting this, and also determining the value of spark resistance under varying conditions, and the effect of the non-uniformity of distribution of the current over the whole section of the conductor. After a summary of the principal results obtained in previous researches, a very complete description is given of the apparatus employed by the authors, and of the experimental results so far obtained. G. W. de T.

356. *The "Singing Arc."* **S. Maisel.** (Elektritschestvo, 24. No. 12. pp. 167–173, June, 1903.)—From a theoretical and practical investigation of the singing arc the following conclusions are derived: (1) Thomson's formula does not, as a rule, apply to the phenomenon in question; (2) the period of the arc depends on the value of the current as well as on the difference of potential at the terminals of the arc; (3) the singing arc is not applicable to capacity, self-induction, or velocity of light measurements in the manner so far in use in this connection; (4) to account for the failure of capacity, &c., measurements, there is no necessity to resort to any hypothesis of a superposition of currents occurring in the singing arc. A. G.

357. *Heat Developed by Oscillatory Condenser Discharges.* **R. Lindemann.** (Ann. d. Physik, 12. 5. pp. 1012–1058, Nov., 1903. From the Göttingen Inaugural Dissertation, 1903.)—The author points out that though the heat developed in the discharge circuit of a condenser has often been measured, no results are available which have been obtained since the theory of the discharge has been better understood. In the present paper he set himself first to measure the total energy of discharge in a simple condenser discharge and the heat remaining in the circuit (all in absolute measure), from which the energy of the spark itself and a mean value of the resistance of the spark can be calculated; secondly, he measures the energy of the currents induced by the condenser discharge, and compares this with the calculated theoretical values. A modification of Paalzow and Rubens' bolometric method is used, the bolometer being standardised by a special device described. A number of tables and curves are given embodying the results and all sources of error and precautions taken to avoid them are discussed. Taking the difference between the total energy of discharge $E = C(P_0^2 - P_\infty^2)$ [where C = capacity, P_0 = potential at first discharge, and P_∞ = potential remaining after discharge] and the heat left in the circuit after the discharge as a measure of the energy absorbed in the spark, he obtains by Riess' formula $E_F(P_0, W, C) = E\,\frac{x}{w + x}$, where E_F is the energy in the spark, and W the resistance in the discharge circuit. From this the mean value of the spark resistance $x = w\,.\,\frac{E_F}{E - E_F} = w\,.\,\frac{E_F/E}{1 - E_F/E}$. At the higher potentials (>5,000 volts) the energy of the spark grows more slowly, also P_0^2 as E_F/E diminishes. From this it follows that with increasing discharge potential the spark resistance diminishes. With increasing resistance in the circuit with constant discharge potential and capacity, the spark energy diminishes, but the resistance of the spark increases. With constant resistance and discharge potential, the energy of the spark increases as the square roots of the capacities (for not too large capacities). With constant resistance, if P_0 and C are simultaneously varied so that the product P_0C remains constant, the spark energies are inversely as the square roots of the capacities. The spark resistance here also decreases with increased capacity. With increase of the self-induction alone, the double effect takes place of the spark energy increasing and the spark resistance decreasing, the resulting change on the bolometer being very small. The energy, and also the resistance, of the spark depend also on other conditions, such as the shape and nature of the electrodes, the pressure, temperature and chemical nature of the surrounding gas. In the present case the measurements were made with sparks between zinc spheres 0·9 cm. radius in air at ordinary temperature and pressure. L. H. W.

358. *Electric Waves in Systems of High Capacity and Inductance.* **L. Hermann.** (Ann. d. Physik, 12. 5. pp. 932–963, Nov., 1903.)—The author was led to the series of researches described in this paper by the study of the transmission of a stimulus along a nerve. A nerve fibre behaves, on the one hand, as if it consisted of two coaxial cylindric conducting layers whose surface of separation is polarisable, and thus capable of producing the effects of a distributed capacity; and on the other, as if it possessed self-inductance. The combined effect of these two is that an electric stimulus travels along a nerve fibre as it would do along a cable possessing distributed capacity and inductance, with a velocity given by $1/\sqrt{lc}$, where l and c stand for the self-inductance and capacity respectively per unit of length. Helmholtz found that the velocity of propagation along the nerve fibres of a frog was 26, and along those of man 43 m. per sec. Such comparatively low velocities of propagation are indicative of very large values of l and c, and the author's aim was to construct an electrical model of a nerve fibre, and to measure the velocity of propagation along it. In the earlier researches the distributed capacity was represented by a set of 15 capillary electrometers, while in the later ones paraffined-paper condensers were used. The inductance was in each case represented by coils of wire, and could be varied within certain limits by inserting or withdrawing cores of soft-iron wire. The velocity of propagation was measured by an "electrograph," which consisted of a capillary electrometer of very fine bore, capable of responding very rapidly to changes of p.d. The wave of p.d. was recorded, first at the beginning and then at the end of the nerve model, by projecting on a moving photographic plate the shadow of the mercury, and that of a thin strip attached to one prong of a tuning-fork; the sine curve traced by the latter marked the time scale. When the paraffined-paper condensers were used, the experimentally determined velocity agreed roughly with that calculated from theory; in the case of the capillary electrometers, however, no good agreement could be obtained, and this the author attributes mainly to the difficulty of measuring the pseudo-capacity of these instruments with any degree of accuracy. Numerous diagrams and specimen records accompany the paper. A. H.

359. *Quantitative Measurements of Electric Waves at a Distance with the Bolometer.* **C. Tissot.** (Comptes Rendus, 137. pp. 846–848, Nov. 23, 1903.)—In a former paper [see Abstract No. 375 (1904)] the author described the use of a bolometer for measuring the energy received by the aerial. Additional results obtained are now described. Waves emitted from one of the author's wireless telegraph stations were definitely detected at 40 km. distance. For the measurements a transmitter station, of less power than usual, 2 km. distant, was used, and the galvanometer sensibility being reduced to 2,500 megs. a deflection of 250 scale divisions was obtained. The deflections obtained with direct and indirect excitation were studied, the period of the emitted waves being measured by photographing the spark as in previous experiments [see Abstract No. 1518 (1901)]. The waves received and measured by the bolometer were simultaneously received by coherers at stations farther away (22–30 miles distant). It was observed that signals with direct excitation were more easily received by the coherer than those by any method of indirect excitation (same watts supplied to coil). On the other hand, if sufficient energy is employed to obtain clear signals with inductive excitation, the ease of reception is practically independent of the period, so that the capacity can be varied from 1–12, and signals still be received by the coherer. The

behaviour of the bolometer is quite different, the effect being much more marked with indirect than with direct excitation ; for instance, with the same exciting current and identical aerials of 40 m. the deflections obtained with direct and indirect excitation were 81 and 64 divisions respectively. Resonance effects are shown very clearly by the bolometer, especially with indirect excitation (only slight damping). With the same exciting watts and aerials of 40 m. on varying the capacity so that it had the following successive values, 1, 1·4, 1·8, 2·2, 2·6, 3, the deflections obtained were respectively 10, 17, 42, 75, 51, and 26, the well-defined maximum corresponding to the capacity 2·2. Measurements of the period by means of the spark gave for this value of the capacity $T = 0{\cdot}52 . 10^{-6}$ sec., from which $\frac{\lambda}{4} = 39$ m. With multiple aerials the position of the maximum and its value changes. With aerials of unequal length for transmitter and receiver there is a maximum in the neighbourhood of that corresponding to the free vibration of the receiver aerial, but the resonance is less marked, and the more so as the periods of the aerials differ. Even with direct excitation the bolometer gives a distinct maximum for equality of aerials. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

360. *Determination of Dielectric Constants by means of Electric Waves.* **W. Schmidt.** (Ann. d. Physik, 11. 1. pp. 114–126, April, 1903.)—In crystals whose dielectric constants in two directions are less than that of water ($e = 81$), it is possible to obtain the constant for the third axis without much trouble by the following method : The crystal is reduced to fine powder and the average value of the constant along the three axes is obtained by determining the constant for the powder. The relation between this average, e_m, and the three principal values is given by the equations—

$$e_m = \frac{2}{\pi}\int_0^{\pi/2}\int_0^{\pi/2} e \cos\phi \, d\phi \, . \, d\omega \quad \text{..........................} \quad (1)$$

where ϕ and ω are spherical co-ordinates, and—

$$e = e_\alpha \cos^2\alpha + e_\beta \cos^2\beta + e_\gamma \cos^2\gamma \quad \text{....................} \quad (2)$$

where e_α, e_β, e_γ are dielectric constants along the axes, and $\cos\alpha = \cos\phi \cos\omega$, $\cos\beta = \cos\phi \sin\omega$, $\cos\gamma = \sin\phi$. If these values be substituted in (1), we obtain the equation $e_m = \frac{e_\alpha + e_\beta + e_\gamma}{3}$. From this it is obvious that if the constant for the powder and for two of the axial directions are known, the third is obtainable. Determinations, made to test experimentally this theory, by a method described in a previous paper [see Abstract No. 712 (1903)], show an agreement of within 3 per cent. between calculated and observed values. Several elements and a number of compounds of lead, thallium, and titanium were examined. The principal results are as follows : Crystallised sulphur and carbon (diamond) follow Maxwell's law $e = \nu_\infty^2$. It is probable that phosphorus and selenium also do so, though this cannot be stated for certain. The high values of the constants for compounds of lead and thallium depend on the metal, while for native oxides of titanium they are due to causes as yet unknown. Coefficients of absorption of electrical oscillations are frequently much affected by slight impurities. J. E.-M.

361. *Conductivity of Selenium and the Intensity of the Incident Light.* **E. A. Hopius.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7, pp. 581–585, 1903.)—The author has made a series of experiments with an apparatus constructed by M. Kohl and another apparatus designed by himself, on selenium supplied by E. Merk, of Darmstadt, the former being illuminated by a standard amyl acetate burner at distances ranging from 10 to 200 cm., and the other by a Nernst lamp placed at the same distances. The measured current intensity agreed fairly well with the hypothesis of a direct proportionality between the increase in the conductivity of selenium and the cube root of the intensity of illumination. A. G.

362. *Behaviour of Selenium with regard to Light and Temperature.* **R. Marc.** (Zeitschr. Anorg. Chem. 37. 3. pp. 459–475, Nov. 30, 1903.)—The experiments described in this paper were made to ascertain the suitability of selenium cells for spectro-photometric purposes, and to elucidate the processes occurring in the cell. A large number of cells with properties as widely different as possible was examined, the selenium used being derived from six different sources, and the cells constructed according to two different methods. As regards the behaviour of selenium with respect to light, permanent and temporary influences should be considered separately. The question as to the kind of light selenium is most sensitive to has been answered by Sale (Pogg. Ann. 150, 333), who found that selenium is most sensitive to the infra-red rays, this sensitiveness decreasing continually from the red through orange, yellow, green, and blue towards violet, and disappearing entirely for actinic rays. [Compare Pfund, Abstract No. 363 (1904).] As shown by the author, this does not correspond exactly with the phenomena observed, the latter being really much more complicated. In fact, the relative sensitiveness with regard to the various colours is different for different temperatures; moreover, the resistance of the cell, as well as its relative sensitiveness to different kinds of light, is found to vary with the voltage, or, what is probably more correct, with the current. In by far the greater number of the cells tested, the sensitiveness to red is, however, found to be higher than the sensitiveness to blue rays. The sensitiveness of selenium to red light is strongly modified by a previous intense illumination with white light, or by a permanent blue illumination. These phenomena are analogous to those observed by Becquerel in connection with the phosphorescence of bismuth compounds, as well as with the action of coloured light on a silver electrode coated with silver chloride. In the second part of this paper the influence of temperature on selenium, which is known to be of quite an extraordinary magnitude, is more closely studied. According as selenium on being heated either increases or diminishes in resistance, non-metallic or "soft" selenium should be distinguished from metallic or "hard" selenium. The former modification is found to be increasingly conductive up to 217° C., when the needle of the galvanometer, after some latent heat has been absorbed, will return suddenly to the deflection corresponding to the temperature 20°. Now if such selenium be cooled in the dark, the resistance, after increasing rapidly for some time, will decrease from + 8° at an increasing rate, the selenium approaching in every respect the behaviour of the other modification. The latter (metallic or hard) modification is generally distinguished by a higher conductivity and a much lower sensitiveness to light than "non-metallic" selenium. On being cooled, the resistance is found to fall at first extremely rapidly, the rate becoming slower at lower temperatures. On being heated,

the resistance of a similar cell will at first increase, falling again from about 70°, when the cell distinctly assumes the properties of the other modification. From the above it is inferred that the metallic modification is stable below 8° and the non-metallic modification above 7°. The latter modification will, even at ordinary temperatures, though at extremely slow rates (often requiring years), be converted into the other form of selenium, this conversion being accelerated by white and especially by red light, whereas blue light will exert an opposite action. The "inertia" of selenium is next dealt with. Though selenium does not exhibit any inertia proper, the action of light is far from being confined to the surface and to the illuminated portion of the cell, as mostly supposed, being transmitted all over the cells, and penetrating even to a certain depth. Special selenium cells, in the case of their being uniformly illuminated, did not show any inertia, reacting instantaneously on any modification in the light impinging upon them. The resistance of all the cells investigated, after reaching a minimum on being illuminated, increased again with continued illumination, becoming constant after some time. As regards the cause to which the photoelectric properties of selenium should be attributed, the author is opposed to Bidwell's opinion that these are due to metallic impurities contained in the selenium. A. G.

363. *The Selenium Cell.* **A. H. Pfund.** (Phil. Mag. 7. pp. 26–39, Jan., 1904.)—The author refers to Bidwell's theory of the action of the selenium cell, in which the phenomenon is ascribed entirely to the selenide, and also to his statement that light produces an increase in the conductivity of a cell by facilitating the molecular rearrangement in the surface layer of a selenide *through which a current is passing.* Particulars are given of the best method of producing a sufficiently pure selenium and of the construction of the cells used in the research, in which carbon was substituted for the metal usually used as electrodes, to prevent the formation of metallic selenides. For the determination, however, of the effect of different regions of the spectrum upon the cell, electrodes of various metals were used. It was found that those cells containing pure selenium were much more sensitive than those containing impure selenium, and much more steady and prompt in their action; with the latter some time is required for a steady condition to be reached, creeping going on for some minutes. With the former the spot moved quickly to a point of steady deflection. The light from different regions of the spectrum was found to give a maximum near 0·7 μ [compare Marc, Abstract preceding], and this maximum had the same position whatever the metal used as electrode. The author points out that the only substance present in every case was the selenium, and he consequently believes that the selenide does not control the selective sensibility of the cell, but rather the selenium itself. He also found that, contrary to Bidwell's view, the influence of light produced the same diminution of resistance whether, during the action of the light, a current was flowing through the cell or not. L. H. W.

364. *Conductivity and Viscosity of Solutions.* **G. Rudorf.** (Zeitschr. Phys. Chem. 43. pp. 257–304, April 9, 1903.)—The maximum conductivity of aqueous acetic acid is at 8·4 N, but at 3·8 N in presence of N/100 NaAc, at 1·7 N in presence of N/40 NaAc, and disappears altogether in presence of N/20 NaAc, the conductivity of which steadily decreases as the proportion of acetic acid in the solvent decreases. In presence of N/40 NaBr the maximum is at 1·8 N, *i.e.*, almost at the same point as with N/40 NaAc. When a correction is made for the conductivity of the acetic acid itself it is found that the conductivity of the salt is reduced by 9·45 per cent. for each equivalent per litre of acetic acid up to normal concentration, but that beyond this concentration the decrement of conductivity is less. If this correction is applied to the conductivity of acetic acid itself, it is found that it obeys Ostwald's dilution law up to 0·6 N, instead of to 0·25 N. It was not possible to find any definite relationship between the percentage decrement of conductivity and the viscosity of the solution. Measurements were made of the viscosity of aqueous solutions of acetic acid, sugar, tartaric acid, urea, acetone, and *normal* and *iso* propyl alcohols. The relationship between concentration and viscosity cannot be expressed either by Arrhenius' exponential formula of $\eta = A^n$ or by a linear formula, and it is suggested that the deviations are due to polymerisation and the formation of hydrates. T. M. L.

365. *Conductivity of Hydrates of Nickel Sulphates in Methyl-alcoholic Solution.* **C. A. L. de Bruyn** and **C. L. Jungius.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 156–159, June 27, 1903.)—A determination of the conductivity of hydrates of nickel sulphate in methyl-alcohol solution was interesting for two reasons: In the first place, in order to ascertain whether the state of the dissolved substance would undergo any variation after more or less prolonged intervals, and, on the other hand, to establish the degree of electrolytic dissociation of the salt. The results obtained point to the conclusion that immediately after the salt has been dissolved in methyl alcohol, a stationary state is produced, the separation of lower hydrates or of alcohol hydrates having to be considered as a retarding phenomenon. It was not possible to determine the degree of electrolytic association, as the conductivity shows the peculiarity of decreasing and reaching a minimum for a certain dilution, and of increasing again for further dilutions. The conductivity of nickel sulphate in methyl alcohol is very low, being at least twenty times less than in water. A. G.

366. *Conductivity of Solutions of Sodium in Ethyl or Methyl Alcohol + Water Mixtures.* **S. Tijmstra Bzn.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 166–169, June 27, 1903.)—On account of disagreements in previous investigations, the author studied the electrolytic conductivity of sodium solutions in mixtures of ethyl or methyl alcohol + water. It is now inferred that methyl alcohol shows a behaviour quite different from ethy alcohol, a minimum being observed in the case of methyl alcohol for the gas concentration. This minimum, while absent at higher concentrations, is noted with increasing distinctness with greater dilution. As the region of the minimum just corresponds with the concentration for which Lobry de Bruyn, and Steger and Lulofs found a maximum of reaction velocity, there must be a parallelism between the two phenomena, a maximum of reaction velocity coinciding with a minimum conductivity in the system methyl alcohol + water + sodium. A. G.

367. *Electrical Conductivity of Aqueous Solutions at High Temperatures.* **A. A. Noyes** and **W. D. Coolidge.** (Amer. Acad., Proc. 39. No. 7. pp. 163–219, Nov., 1903.)—The paper contains a detailed description of a cell or bomb for the determination of electrical conductivity of aqueous solutions at high temperatures. This bomb is made of soft crucible steel, and is lined throughout with sheet platinum 0·41 mm. thick. It is made in two parts, the upper one having an inside screw-thread and acting as a nut, into which the lower part is screwed. The joint is made tight by means of a ring of pure gold wire, which lies in a groove in the rim of the platinum lining. One electrode consists of a platinum-covered steel plate, situated within a hollow cylinder of quartz, closed at one end and open at the other, the function of which is to increase the resistance of the cell. The other electrode is the inner surface of the bomb itself; and a third or auxiliary electrode is provided at the top. This is in the form of a long rod, and is used to determine the volume of electrolyte in the cell; the resistance from the wall of the bomb to the rod being a measure of the height to which the liquid reaches up the rod. The conductivity was measured by the Kohlrausch-Wheatstone bridge method, using an induction coil and telephone, the cell-constant being first determined by means of standard solutions of both sodium and potassium chloride. Observations of the molecular conductivity of sodium and potassium chlorides were made at temperatures 26°, 140°, 218°, 282°, and 306° Centigrade, and the authors hope to be able soon to extend the observations to the critical temperature of water. With each observation a determination of the specific volume is made, thus enabling the authors to calculate the concentrations used. The solutions varied from 0·0005 to 0·1 normal. An accuracy of 0·2 or 0·3 per cent. was obtained throughout. Several of the equations which have been put forward to express the relationship between molecular conductivity and concentration, are examined by the aid of the experimental results obtained; and it was found that Kohlrausch's formula, $\Lambda_0 - \Lambda = \kappa c^{\frac{1}{3}}$, where Λ_0 is the molecular conductivity at infinite dilution, and κ is a constant, represents the truth at all temperatures somewhat more closely than the expressions given by Barmwater ($\Lambda_0 - \Lambda = \kappa\Lambda^{\frac{1}{3}}c^{\frac{1}{3}}$), van't Hoff ($\Lambda_0 - \Lambda = \kappa\Lambda^{\frac{3}{2}}{}^{\frac{1}{2}}$), and Ostwald ($\Lambda_0 - \Lambda = \kappa\Lambda^2c^{\frac{1}{2}}$). The ratio of the molecular conductivities of potassium and sodium chlorides varies from 1·19 at 18° to 1·04 at 306°, and the degrees of dissociation of the two salts are nearly identical at all temperatures and concentrations. S. G. S.

368. *Cooper-Hewitt Current Interrupter.* (Elect. Rev. N.Y. 42. pp. 264–266, Feb. 21, 1903.)—The mercury vapour lamp has the property that its resistance is maintained, as the p.d. between the terminals rises, up to a value varying over a large upward range from about 2,000 volts, depending on the size, shape and temperature of the tube, and other features, when it suddenly collapses, rising instantaneously to its initial value as soon as the p.d. falls below the critical point. This renders a mercury vapour column an effective current interrupter, and it has been used successfully with a frequency calculated as exceeding a million discharges per sec. G. W. de T.

369. *Electrical Conductivity of $VOCl_3$ Solutions.* **A. Agafonoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 6a. pp. 649–651, 1903.)—E. P. Osspoff some time ago observed that when keeping aqueous $VOCl_3$ solutions in closed vessels for some time, the liquid, which formerly was colourless, would acquire an intense lemon colour, showing that a chemical action had probably taken place. To confirm this hypothesis, the author investigated the electric conductivity of such solutions, using Kohlrausch's telephone method. These experiments are to be continued. A. G.

370. *On Coherers.* **Hurmuzescu.** (Annal. Scientifiques de l'Univ. de Jassy, 2. pp. 141–165, March, 1903.)—The author gives an account of his

investigations into the action of coherers with electrodes of various metals, and powders of different kinds. The following is a short summary of his conclusions: (1) In a general way metal filings become good conductors under the action of electric waves. (2) All coherers have a certain minimum resistance with reference to the time during which the oscillations are applied, after which time the resistance increases again. (3) The change of resistance is permanent for most systems, but a number of substances are self-restoring—carbon-carbon, metal-carbon, metal-mercury, &c. (4) All systems lose their decohering property by reason of oxidation or fatigue from too intense oscillations. (5) Certain systems, Fe-Mn, Ag-Mn, first decrease in resistance, and then, on waves again acting, increase in resistance. (6) A large number of ordinary coherers may present both these phases in which the first is more or less shortened, and may even in some cases disappear. (7) All these phenomena depend on a layer between the surfaces in contact. This layer is the dielectric of separation, be it in the space itself, in the oxide, or furnished by the gas condensed on the surfaces themselves.
L. H. W.

371. *New Form of Self-restoring Coherer.* **O. Lodge.** (Roy. Soc., Proc. 71. pp. 402–403, April 30, 1903.)—The author describes the mercury coherer, devised by himself and A. Muirhead with the assistance of E. E. Robinson, which has already been dealt with in Abstract No. 1064B (1903) describing the Lodge-Muirhead wireless telegraph system. L. H. W.

372. *Magnetic Detector for Hertzian Waves Adapted for Quantitative Work.* **J. A. Fleming.** (Roy. Soc., Proc. 71. pp. 398–401, April 30, 1903.)—The author describes an adaptation of the solenoidal form of Rutherford detector. For this purpose he makes a multiple core of seven or eight small bundles of iron wire, each about 6 in. long, each bundle having its separate magnetising coil of one layer of No. 36 wire, and over this a demagnetising coil of one layer of No. 26 wire. Exterior to this multiple core is a secondary having a resistance of about 6,000 ohms. The magnetising coils are joined in series so that the iron wires have contiguous ends of the same polarity; the demagnetising coils are in parallel. A rotating commutator, making about 500 r.p.m., causes a cycle of operations to take place in which first the iron bundles are magnetised while the secondary coil is short-circuited and the galvanometer disconnected. Shortly after the magnetising current is broken, the secondary circuit is opened again, and immediately afterwards closed through the galvanometer, remaining so the rest of the cycle. If electrical oscillations pass through the demagnetising coils whilst the core is left magnetised, the effect is shown by a deflection in the galvanometer. Since the commutator is revolving rapidly, if the oscillations continue, the result will be a steady deflection proportional to the demagnetising force, other things being equal. Particulars of some uses of the detector are then given. L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

373. *Variation in the Magnetic Moment of Permanent Magnets.* **W. Chiptchinsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 6b. pp. 541–553, 1903.)—After pointing out that for some decades past no

methodical investigation has been made into the temporary variation of permanent magnets, the author gives his recent measurements in this connection. For the interval between 1888 and 1902 the annual mean values of the magnetic moments of three magnets are given, one of which belongs to the Brauer theodolite used in the Pawlovsk Observatory, the two others to that of Freiberg. The annual variation of the moment is found to be 1·62 per cent. for the former and 0·03 per cent. for the two latter magnets.

A. G.

374. *Apparatus for the Determination of Magnetic Constants.* **P. Curie** and **C. Chéneveau.** (Journ. de Physique, 2. pp. 796–802, Nov., 1903. Communication made to the Soc. Française de Physique, April 3, 1903.)—This is a torsion balance meant to be used for examining bodies only slightly magnetic. One end of the beam carries a glass tube in which is the substance to be examined. The other end of the beam carries a micrometer scale which is viewed by a microscope, the suspending thread is of platinum. The glass tube hangs in or near an isthmus formed in a circular permanent magnet so that by moving the magnet the movement of the tube will indicate whether its contents are para- or dia-magnetic. Measurements can be made of (1) relative values of susceptibility for various bodies; (2) exact value of a susceptibility, if a standard, say water, is experimented with separately. Correction is made for the magnetic constant of the glass in the tube used. The absolute specific magnetisation of pure radium chloride was found to be $1{\cdot}05 \times 10^{-6}$, which places it among the paramagnetics.

P. E. S.

375. *Magnetic Effect suitable for the Detection of Electrical Oscillations.* **C. Tissot.** (Comptes Rendus, 136. pp. 361–364, Feb. 9, 1903.)—The author, after referring to Marconi's magnetic detector [see Abstract No. 1060 (1903)] and the Rutherford detector, gives particulars of an arrangement in which such a detector is used with a Thomson galvanometer in place of the magnetometer. The effect of oscillations was detected by this means up to 4 km. distant. A bolometric device was also used, in both cases the object being to obtain quantitative indications of the phenomena in the aerial. The bolometer was of the Rubens type, inserted in a bridge arrangement, and readings were taken on a galvanometer. The bolometer gave the quantity $\int C^2 dt$, comprising the total duration of the induced currents in the aerial. The magnetic detector gave a different reading. A comparison of the two apparatus enabled a study of the progress of the phenomena to be made under different conditions of transmission. Marconi considered the effect of the oscillations was to produce an abrupt diminution of the time lag in the magnetisation, whereas the author considers, as the result of these experiments, that it is the hysteresis proper which is affected. The effect appears to be practically independent of the speed of variation of the field, and is greater in steel than in iron, those samples enclosing a large area in their cyclic curves giving the best results; the effect also is more intense when the induction is increasing than when decreasing. The author considers a sensibility comparable to that of a coherer is obtainable. The detector was made in two forms, the first resembling the Marconi detector with fixed core, and the second resembling the form with movable core. In this latter the core took the form of a steel ring, wound like a Gramme ring, which was rotated between the poles of an electromagnet, four slip-rings being provided on the shaft, the brushes being connected one each to the aerial and earth, and the other two to the telephone. Distinct signals were received at 25 to 30 miles distance, when using less energy than usual at the transmitter. L. H. W.

376. *Suppression of Magnetic Hysteresis by the Action of an Oscillatory Magnetic Field.* **C. Maurain.** (Comptes Rendus, 137. pp. 914–916, Nov. 30, 1903.)—The author refers to the action of a rapidly varying field upon the magnetisation produced under ordinary conditions. As a result of precise, quantitative experiments he considers Tissot's hypothesis as opposed to Marconi's is confirmed [see Abstract No. 375 (1904)]. The author's conclusions are: It is the hysteresis with reference to the field which is affected and even completely suppressed. With an iron or steel core exposed to a cyclic magnetic field, and at the same time to a field oscillating in the same direction, one obtains, instead of the well-known cyclic magnetisation curve with two branches, a single curve on which lie all the points obtained with either increasing or decreasing field—that is, if the core is sufficiently thin for the oscillatory field to penetrate with sufficient intensity to the central portion. In the thinnest non-tempered specimens suppression of hysteresis was complete; with slightly thicker specimens, the curves were separated, but less than in normal magnetisation. Tempered specimens gave the same results, but required more powerful oscillations for a complete suppression of the hysteresis. With iron powder suppression was complete. The values of the induction obtained during the action of the oscillations were higher than those obtained under ordinary conditions. These results were obtained with cores made of watch hair-spring, thin wire and iron powder in paraffin. On the core were two long bobbins, the outer for the magnetising current, the inner for the oscillations from a spark-coil the primary of which was supplied with alternating current, a small spark-gap being in circuit. For each core a cyclic curve was constructed, first without, and then with oscillations passing through the inner winding. When the primary of the coil was supplied with a continuous interrupted current, different results were obtained owing to the asymmetry of the induction. The oscillations produced a strong magnetisation in one direction, which persisted after they ceased (the alternating current had produced no magnetisation whatever). When a specimen is taken through a magnetic cycle while exposed to such an asymmetric effect the magnetisation curve obtained, for zero value of the field, passes through the point representing the magnetisation due to the oscillations instead of through the origin, and the curve is only reversible in that part where the direction of the magnetising field is the same as that due to the oscillations; in other parts the two branches are slightly separated. The continuous action of oscillations enables one to obtain, with sufficiently thin specimens, reversible curves rising rapidly from the origin without an inflection point. The author finally points out that the experiments provide a method of studying the penetration of an oscillatory field (as a function of the frequency) into magnetic cores or into metal screening such cores. L. H. W.

377. *Suppression of Hysteresis by an Oscillatory Magnetic Field.* **P. Duhem.** (Comptes Rendus, 137. pp. 1022–1025, Dec. 14, 1903.)—The author refers to the paper by C. Maurain on the above subject [see preceding Abstract], in which the latter considers the hypothesis of Tissot, as to the cause of this effect, to be confirmed. The author now calls attention to his theory of the phenomenon of hysteresis, which he has already published [see Abstract No. 82 (1901)]. In this theory a special part is played by a line which he calls the line of Natural State (call this line N_l), this being in the plane in

which the abscissæ are values H of magnetic field, and the ordinates values B of induction, passing through the origin and symmetrical about this point. The author considers that the theory advanced in his paper to the Academie de Belgique (52, May 7, 1901) gives a complete representation of the phenomena observed by various experimenters, and particularly by Maurain and M. Wien. Among the questions dealt with there the following applies here: A magnetic field undergoing a double symmetrical oscillation between two finite values $-\eta$ and $+\eta$, what is the limiting form of the effect as the period of the oscillation tends towards 0? He finds that the magnetic cycle very rapidly described is equivalent to a cycle very slowly described between two infinitely small values; that is, it *does not magnetise* the iron. (It is, in fact, generally admitted that a magnetic action oscillating extremely rapidly round about the value 0 cannot of itself magnetise iron.) It follows that if a piece of iron is simultaneously subjected to two finite fields of the same direction, the one of constant value H_0 and the other oscillating extremely rapidly between two equal values of opposite sign $-\eta$ and $+\eta$, the effect is the same as if it were subjected to a field describing very slowly, very small and very numerous oscillations about the value H_0. From Prop. I. of his theory the value will tend towards B_0 at the value H_0 of the abscissa on the line N_l. The author finally points out that if his hypotheses are correct, mechanical vibrations should give the same curve as Maurain obtains with electrical oscillations, this *normal curve* of Maurain being identical with the line of Natural State of the author. The accord of the author's theory with the results hitherto obtained by experiment, including those of Ewing and Rayleigh, leads him to expect from this another confirmation thereof. He considers, as opposed to Marconi and Tissot, that the effect is due to the simultaneous action of viscosity and hysteresis, and that it is precisely the viscosity which brings about the suppression of the hysteresis. L. H. W.

378. *Distribution of the Total Magnetic Force in France in* **1896. E. Mathias.** (Comptes Rendus, 137. pp. 916–918, Nov. 30, 1903.)—For the majority of the 617 stations of Moureaux' magnetic survey of France, the difference between the total force of a station and that of the Toulouse Observatory can be expressed as a function of the second degree of the differences in longitude and latitude. The author gives the formula [see Abstract No. 505 (1902)] for the distribution of the total magnetic force in France and Corsica on January 1, 1896. Regularity of the total force is compatible with anomalies in declination of $\pm 20'$. It would appear that the total force assumed for Toulouse, 0·45050, is too small by 16 units of the fifth place. H. B.

379. *Gravity and Magnetic Survey in Eastern Asia.* **S. Shinjo, R. Otani, and K. Yamakawa.** (Mathematical and Physical Soc. Tokyo, 2. 4. pp. 41–53, 1903.)—The authors have made determinations of gravity and of the magnetic elements at Singapore, Hongkong, and Zikawei, at which stations officers of the Austro-Hungarian Navy had carried out similar work in the course of the years 1893 to 1898, and also at Tokyo, Hankow, and Shansi. The instruments were the same which they had used in Tokaido. Their gravity figures differ slightly, and always in the same sense, from the previous observations. The redetermination of the magnetic elements suggests that the declination (W), the dip (N), and the horizontal intensity are increasing. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

380. *Röntgen-ray Tube of Variable Hardness.* **A. Wehnelt.** (Deutsch. Phys. Gesell., Verh. 5. 14. pp. 259–260, July 30, 1903. Also Archives d'Él. Médicale, 11. pp. 701–702, Nov., 1903.)—The author has previously demonstrated that the potential of a tube is a function not only of the pressure and of the distance between the electrodes, but also to a considerable degree of the relative position of the kathode and the walls of the tube. The new tube, constructed by E. Berger, is provided with a movable glass cylinder one-half of which is narrowed and fits over the glass rod which supports the kathode, while the other portion is widened to a diameter a little greater than that of the kathode, and can be made to slide forwards by gently tapping the kathodal end of the tube, so as to form a sheath around the kathode and project a varying distance beyond it. The length of the spark necessary to work the tube can be increased as much as eight times by advancing the glass sheath to its full extent. By this arrangement the same tube can be adapted for parts of the body of different thickness and density. H. W. P. Y.

381. *New Finsen-light Apparatus.* **A. Bellini.** (Revue Int. d'Électrothérapie, 13. pp. 133–142, Nov., 1903.)—The lamp is on the same principle as the Finsen-Reyn lamp. Opposite the arc, the carbon electrodes of which are placed at an angle, there is a dioptic apparatus in the form of a truncated cone filled with distilled water and cooled by a water coil. The smaller end of the cone is closed by a quartz disc, which also acts as the compressor. In the centre of the larger base of the cone a ring is fixed which carries two plano-convex quartz lenses with their convex surfaces in contact. They serve to concentrate the rays, and, being cooled by the distilled water, can be placed 3 cm. from the arc without danger of cracking. The light (at 20 amperes and 55 volts) possesses a penetration equal to that of the Finsen apparatus. The apparatus is so constructed that the weight of the lamp can be made to act as the compressing force. H. W. P. Y.

382. *Electrical Resistance of the Human Body.* **S. Leduc.** (Comptes Rendus, 137. pp. 814–816, Nov. 16, 1903.)—The electrical resistance of the human body is chiefly that of the skin, and this is dependent on its chemical composition; that is, on the nature and number of the ions it contains. It does not depend on the degree of moisture, for on closing a circuit of low voltage (2 volts), the intensity of the current attains its maximum immediately and remains constant, in spite of the fact that prolonged contact with the wet electrode increases the moisture of the skin. Neither does it depend on the amount of blood flowing through the skin, since the electrolytic introduction of adrenalin does not increase the resistance, although it produces extreme vaso-constriction. H. W. P. Y.

383. *Physiological Action of Certain Ions.* **S. Leduc** and **A. Bouchet.** (Archives d'Él. Médicale, 11. pp. 678–685, Nov., 1903.)—The indifferent electrode used in the experiments, was of large size, while a small pad of cotton-wool impregnated with a 1 per cent. solution of the substance to be studied formed the active electrode. Oxalic acid, sodium, cocaine chlorine, and adrenalin were tested as ions. At intervals of five minutes the voltage was raised 2 volts, beginning at 2 volts. The intensity of the current was found not to follow Ohm's law, nor was the increase regular, the figures

differing according to the ion employed. With oxalic acid, as the e.m.f. rose from 2 to 12 volts, the current increased from 0·5 to 22 milliamperes. With adrenalin, as the voltage increased in the ratio of 1, 2, 3, 4, the current increased in the ratio of 1, 3, 19·6, 29. For a given ion the variations of the resistance of the skin depend on the rapidity of introduction. The penetration of adrenalin into the skin under the influence of the electric current is indicated by intense anæmia of the area in contact with the electrode, and around this a zone of congestion can be seen. The greatest intensity of the anæmia is seen when the current attains a density of 0·5 milliamperes per sq. cm. Muscular tremors were observed after the introduction of adrenalin by this method. H. W. P. Y.

384. *Introduction of the Salicylic Ion by Kataphoresis.* **C. Roques.** (Archives d'Él. Médicale, 11. pp. 689–697, Nov., 1903.)—In this treatment for arthritis a bath of a 3 per cent. solution of sodium salicylate connected with the negative pole is used for the limbs; for other parts the negative electrode, covered with absorbent material saturated with the same solution, is applied directly. The indifferent electrode, of large size, is placed on the skin of a healthy part of the body. The current employed varies from 15 to 40 milliamperes. The sittings lasted from 45 to 60 minutes, and are repeated every other day, sometimes more frequently. The entrance of salicylic acid into the body is proved by its appearance in the urine. The author obtained excellent results, which in the majority of cases were permanent. H. W. P. Y.

REFERENCES.

385. *Electromagnetic Theory of Selective Absorption in Isotropic Non-conductors.* **M. Planck.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 24. pp. 480–498, April 23–30, 1903.)—The author develops the theory referred to in Abstract No. 1078 (1903), which is cognate to H. A. Lorentz's, and extends it to a wide range of possible cases of maximal, minimal, or medium values of the extinction coefficient, and different physical states of the absorbent, with corresponding distributions of the resonating and radiating molecules. A comparison with other theories and with experimental results is made. A. D.

386. *Electrons.* **T. Tommasina.** (Écl. Électr. 37. pp. 281–290, Nov. 21, 1903.)—The author comments on Lodge's exposition [see Abstract No. 1466 (1903)]. He represents Lodge's theory as being that the electron is a special fluid mass moving through the ether, whilst the author maintains that it is a special form of ether motion capable of propagation through the ether without causing any displacement of the latter. G. W. DE T.

387. *Impossibility of Undamped Vibrations in an Unbounded Dielectric.* **W. McF. Orr.** (Phil. Mag. 6. pp. 667–673, Dec., 1903.)—H. M. Macdonald, in his Adams Prize Essay, arrived at the result that an indefinitely extended multiply-connected space possesses modes of free oscillation which do not involve loss of energy by radiation, and are therefore absolutely permanent. The author proves that this conclusion, which had already been challenged by Larmor and Pocklington, is erroneous. G. W. DE T.

388. *Measurement of Conductivity of Solutions.* **M. Cantor.** (Zeitschr. Elektrochem. 9. p. 922, Nov. 19, 1903.)—Apparatus to hold the solution, in which the electrodes are fixtures, while the whole can be lifted out from between the battery terminals, which are also fixtures. A. D.

389. *Conductivities of Substances Dissolved in Certain Liquefied Gases.* **B. D. Steele** and **D. McIntosh**. (Chem. News, 88. pp. 268–269, Nov. 27, 1903. Paper read before the Chemical Society.)—Measurements of the conductivities of certain salts in liquefied HCl, HBr, HI, H_2S, and H_3P. No general conclusions appear to have been arrived at. F. G. D.

390. *Self-inductance and Dimensions of Large Spark Coils.* **J. E. Ives.** (Phys. Rev. 16. pp. 112–114, Feb., 1903.)—The author records the dimensions and self-inductances of seven coils, six of which contain 5,000 ft. of wire, and one 10,000 ft. [See also Abstract No. 670 (1903).] G. W. DE T.

391. *Investigation into the Discharge of a Static Machine.* **J. Januskewitch.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. p. 607, 1903. Paper read before the Russian Physico-Chemical Soc. (Section Physics), Sept. 22, 1903.)—Experiments are described relative to the influence of a point, connected to one of the electrodes of a machine, and separated from the poles of the latter by a glass plate, on the sparking distance, and to the influence of a charged point on an electroscope placed in a metallic vessel connected to earth, the ball of the electroscope being coated on the side of the point with a metallic layer. The author also refers to a device of his own for rapidly changing the charge of a machine. A. G.

392. *Discharge in a Gas near a Glowing Electrolyte.* **E. Rasch.** (Ann. d. Physik, 11. 1. pp. 202–206, April, 1903.)—A criticism of papers on the same subject by E. Bose. [See Abstract No. 947 (1903).] R. S. W.

393. *On the Mutual Influence of Kathode Rays.* **F. Neesen.** (Deutsch. Phys. Gesell., Verh. 5. 18/19. p. 296, Oct. 15, 1903.)—To show that the absence of any mutual action of different kathode rays upon one another does not depend upon an oppositely acting electrodynamic action, the author causes two sets of kathode rays to be produced in one tube from two separated discharges in opposite directions and in close proximity to one another. Even in such a case no mutual action is observed, although the electrodynamic action here assists the electrostatic effect. L. H. W.

394. *Unipolar Conduction in Gases.* **H. Starke.** (Deutsch. Phys. Gesell., Verh. 5. 21. pp. 377–380, Nov. 15, 1903.)—The current in a gas is often very different according to the direction of the field. Such cases are here classified. R. S. W.

395. *Conduction in Flames.* **E. Marx.** (Deutsch. Phys. Gesell., Verh. 5. 24. pp. 441–454, Dec. 30, 1903.)—A polemic with H. Starke concerning the interpretation of well-known experiments by the author, H. A. Wilson, and Moreau. No new experiments are given. [See preceding Abstract.] R. S. W.

396. *Theory of the Gramme Ring.* **K. R. Johnson.** (Phys. Zeitschr. 4. pp. 372–374, April 1, 1903.)—In continuation of his former paper [see Abstract No. 1244 (1903)], the author extends his theoretical investigations to the case in which the ring is allowed to supply current to an external circuit by acting either as a continuous or as an alternating-current generator. The results established for a simple sine distribution of the magnetic field are then generalised by applying the same mode of investigation to a distribution represented by a Fourier series. A. H.

397. *Measuring Apparatus for Electric Oscillations.* **P. Drude.** (Deutsch. Phys. Gesell., Verh. 5. 18–19. pp. 294–295, Oct. 15, 1903.)—The author describes the latest form of his apparatus for measuring the wave-lengths in an oscillatory circuit (the instrument described has a range of λ from 2 to 400 metres), and also the standard inductance coils, by means of which the variable condenser used can be standardised. The method has already been described in Abstract No. 839 (1903). L. H. W.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

398. *On Crystals.* **G. Quincke.** (Deutsch. Phys. Gesell., Verh. 5. 5. pp. 102–109, March 15, 1903.)—The ordinarily invisible "foam-walls" separating the two solutions of a colloid become visible as crevices, cracks, or fissures when the colloid dries, owing to the unequal rate of contraction of the two solution-phases. The author considers that there is no qualitative difference between ordinary crystalline salts and colloids, and concludes therefore that the former give with water two coexistent solution-phases, A and B, and that crystals are "foam-networks," the walls of the "foam-cells," consisting of solidified A (the phase richer in salt) enclosing solidified B. The fissures of dried colloids correspond to the cleavage-planes of crystals. A detailed account is given of observations which prove, according to the author, that crystals really possess a cellular foam-structure, similar to that exhibited by true colloids. For an account of these details reference to the original paper must be made. F. G. D.

399. *Preparation of Large Quantities of Argon.* **K. Prytz.** (Deutsch. Phys. Gesell., Verh. 5. 10. pp. 206–207, May 30, 1903.)—The following pieces of apparatus are arranged in a circle and connected to each other by tubing: (1) A flask with two oppositely situated tubes, (2) a large steel tube containing magnesium, (3) a small steel tube with magnesium, (4) a pump to maintain a circulation of air through the apparatus. The circuit also contained tubes for the absorption of moisture and carbon dioxide. The steel tubes are placed in separate furnaces. To one part of the circuit a tube is attached, which is filled with copper, lies in a furnace and communicates with the outside air. The tube filled with copper and the large steel tube are both heated to redness and the pump set going. After several hours the apparatus is closed, and the last traces of nitrogen removed from the enclosed gas by heating the small steel tube. Fifty litres of air in eight hours gave ½ litre of argon. F. S.

400. *Atomic Weight of Fluorine.* **J. Meyer.** (Zeitschr. Anorg. Chem. 36. 3. pp. 313–325, Sept. 16, 1903.)—Whereas the atomic weights of chlorine, bromine, and iodine are known with a high degree of certainty, this constant in the case of fluorine is only approximately given, though the atomic weight of fluorine has served as a basis in determining the equivalent value of other elements such as niobium, tantalum, silicon, and zirconium, where the errors of one determination will be transmitted to an ever increasing extent from one element to another. The author discusses the method used in the case of former determinations and the error involved, it being shown that the two following conditions should be satisfied: (1) There should be found a chemical relation between fluorine and an element with an atomic weight as well known as possible. (2) The chemical process should be as simple as possible, avoiding as much as possible any such operations as filtering, precipitating from solution, titrating, &c. The reaction $CaO + 2HFl = CaFl_2 + H_2O$ is shown to correspond with all these requirements. In the calculations, the atomic weight of oxygen is given as unit, that of calcium having been ascertained by two recent researches agreeing well with one another; moreover, small errors in determining the atomic weight of calcium will be transmitted to the fluorine constant to a still smaller extent. Taking the atomic weight of calcium as 40·186 (with a probable error of $\pm 0·0033$), the atomic weight of fluorine becomes 19·036 (with a probable error of $\pm 0·00149$), this value being somewhat higher than the one found by Christensen, and a little smaller than the mean value of Moissan's determinations, whereas F. W. Clarke gives in his "Recalculation of the Atomic Weights" the value 19·056. A. G.

401. *Density of Colloidal Silver.* **P. J. Cholodny.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. pp. 585–603, 1903.)—The discovery of metallic solutions has afforded precious material for the investigation of colloids. Here, in fact, one is in presence of an ideal simplicity in the state of the dissolved body, in addition to the dissolved substances being so characteristic and possessing properties so well investigated as those of gold, silver, copper, mercury and platinum. If therefore the property of the body of presenting itself in the colloidal state be related to a variation in its physical constants, this should manifest itself here with a clearness impossible in the case of any other substances. The author has prepared aqueous solutions of colloidal silver, from 10 to 21·8 per cent. according to the following method suggested by Carey Lea: To a mixture of 140 c.cm. of a 40 per cent. sodium citrate solution, 90 c.cm. of a 30 per cent. iron sulphate, and 25 c.cm. of a 10 per cent. sodium carbonate solution, 100 c.cm. of a 10 per cent. silver nitrate solution were added. After concentrating the blue precipitate by means of a centrifugal device, a mass easily soluble in water and yielding stable solutions was obtained. The author, after determining the density of a solution thus prepared by means of a pycnometer, precipitates the silver by stirring the solution with a sulphur solution in carbon disulphide, and measures once more the density of the solvent, freed from silver. The amount of silver contained in the primitive solution was determined by converting the same into chloride. The density X of the dissolved silver contained in an amount A of the primitive liquid, the solvent of which possesses a density δ and a mass B, and contains an amount M of silver, may be derived from the formula $A = B + M - \frac{M}{X}\delta$. The author has obtained for X the values 10·66, 10·63, 10·59, and 10·58, whereas the density of metallic silver has been found by different investigators to be intermediate between 10·57 (cast silver) and 10·59 (powdered silver). A. G.

402. *Filamentous Carbon.* **Constant** and **H. Pélabon.** (Comptes Rendus, 137. pp. 706–708, Nov. 2, 1903.)—When the carbonisation of fatty coal, for the preparation of coke for metallurgical purposes, is carried out in open furnaces and especially when these are of the old type, a deposit of filamentous carbon resembling wool is often obtained. This material, which is formed above the coke in the hottest part of the furnace, is practically pure carbon, the percentage of ash being very small. It has approximately the same properties as the carbon obtained by passing cyanogen over a mixture of retort carbon and cryolite at a red heat. T. H. P.

403. *Revision of the Atomic Weight of Iron. Analysis of Ferrous Bromide.* **G. P. Baxter.** (Amer. Acad., Proc. 39. 9. pp. 245–256, Nov., 1903.)—The Author has made a very careful redetermination of the atomic weight of

iron. For this purpose ferrous bromide was used, and the result obtained is the same as that yielded previously by analysis of the oxide, namely, 55·88 (O=16·000). The specific gravity of the ferrous bromide was found to be 4·636 at 25°, referred to water at 4°. The author also carried out several experiments which showed that the effect of the earth's magnetism on the weights of small quantities of the magnetic metals is negligible in even the most precise atomic weight work. A. F.

404. *Separation of Liquid Oxygen from Air.* **G. Claude.** (Comptes Rendus, 137. pp. 783–786, Nov. 16, 1903.)—The author has already shown that when air is liquefied the first portions are very rich in oxygen. This result is in accordance with the theories of Gibbs, van der Waals, and Duhem. He has devised an apparatus which makes it easy to separate the oxygen from the nitrogen of air. It consists of a bundle of seven tubes of copper 2 m. long and 13 mm. inside diameter, which are placed within a metallic vessel. This vessel contains liquid air up to a height equal to two-thirds of the length of the inner tubes. At the top and at the bottom the tubes terminate in bell-shaped receivers. Air compressed to about 2 atmospheres (cooled by passing through a worm immersed in liquid air to a temperature of − 160°) is passed into the tubes. The air as it ascends is partially changed to the liquid form, and is collected in the lower receiver. The gaseous residue passes through a stop-cock fixed in the upper vessel. A manometer indicates the pressure, which varies up to 2 atmospheres according to the regulation of the tap. The lower the pressure the less rapid is the condensation, but, on the other hand, the richer the product. With a pressure of 0·7 atmosphere all the oxygen can be separated with the evaporation of 57 parts of the liquid air surrounding the tubes for every 100 parts of oxygen condensed—a very economical result. With the apparatus described about a third of a litre of liquid is obtained per minute. With a larger apparatus 30 to 40 cub. metres of oxygen per hour can be obtained. W. W. H. G.

405. *New Method of Preparing Argon.* **H. Moissan** and **A. Rigaut.** (Comptes Rendus, 137. pp. 773–777, Nov. 16, 1903.)—The main feature of this method is the shortening of the process of final purification of the argon from the remaining traces of nitrogen and hydrogen by passing it over crystals of calcium raised to a dull red heat. As previously shown by one of the authors, calcium combines directly with nitrogen, at a dull red heat, to form a nitride (Ca_3N_2). It also forms a hydride (CH_2) which is stable at temperatures below 500° C. The preparation is conducted in four stages. (1) Preparation of 100 litres of atmospheric nitrogen. (2) Absorption of the greater portion of the nitrogen by passage over heated tubes containing a mixture of powdered quicklime and magnesium dust, and of the impurities by ordinary methods. This process reduces the volume to 10 litres containing 5 to 10 per cent. of argon. (3) Further absorption of nitrogen and impurities by pumping through a previously exhausted system of tubes containing heated lime-magnesium mixture and through other absorption apparatus. The resulting gas consists of argon with 5 to 10 per cent. of nitrogen. (4) Final purification. The gas from the previous operation is pumped through two tubes at a dull red heat, the first containing lime-magnesium mixture, which absorbs most of the remaining nitrogen; the second containing calcium crystals, in small nickel boats, which absorb the remaining traces of nitrogen as well as the hydrogen which is given off in small quantities from the lime-magnesium mixture. The yield of argon is 250 c.cm. The apparatus used in (3) and

(4) is vacuum tight, the circulation and collection of the gas being performed by mercury pumps. Details of the apparatus are given, and the authors state that two persons can produce 1 litre of argon in twelve hours. J. D. C.

406. *Densities of Concentrated Nitric Acid at Different Temperatures.* **V. H. Veley** and **J. J. Manley.** (Soc. Chem. Ind., Journ. 22. pp. 1227–1229; Discussion, pp. 1229–1230, Nov. 30, 1903.)—The nitric acid was carefully purified from oxides of nitrogen by fractional distillation in vacuo, and from HCl and H_2SO_4 by redistillation over $AgNO_3$ and $Ba(NO_3)_2$. The densities were determined by a modified Sprengel pycnometer. Tables are given of the densities of acid, varying from 62·8 to 100 per cent. at the temperatures 4°, 10°, 15°, 20°, and 25°. The densities are given to the third decimal.

F. G. D.

407. *Contribution to the Question of Molecular Weight of Dissolved Sulphur.* **G. Timofeeff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 6a. pp. 644–646, 1903.)—The results obtained by the author by means of the Beckmann apparatus after the boiling-point method in its second form are as follows:—

Partial weight of sulphur in	$CHCl_3$	193	$S_6 = 192$
" " "	CS_2	250	$S_8 = 256$
" " "	C_6H_6	151–313	$S_5 = 160$; $S_9 = 288$; $S_{10} = 320$.

A. G.

408. *Researches on the Density of Chlorine.* **H. Moissan** and **B. du Jassoneix.** (Comptes Rendus, 137. pp. 1198–1202, Dec. 28, 1903.)—The authors have determined the density of chlorine, which they prepared with special precautions from pure hydrochloric acid and manganese dioxide, the hydrochloric acid being prepared from pure sodium chloride and sulphuric acid. The first method they employed was that of Dumas, and it was noticed that in this case the density found can vary between 2·424 and 2·506 at ordinary temperatures. The authors then proceeded to eliminate the various sources of error, which arise from presence of air given off from the density globe, or are due to the difficulty of completely drying the chlorine. As the final result they obtained the number 2·490 as the density of chlorine at 0°. A. F.

409. *Oceanic Salt-deposits.* XXX. *Isomorphous Mixtures.* **J. H. van't Hoff** and **H. Barschall.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 18. pp. 359–371, March 26, 1903.)—The ordinary orthorhombic crystals of sodium and potassium sulphates are not isomorphous, and cannot form mixed crystals to any appreciable extent. The mineral glaserite, which has approximately the composition $K_3Na(SO_4)_2$ (78·7 per cent. K_2SO_4), forms hexagonal crystals which differ entirely from those of sodium and potassium sulphates, and have a higher density. The minerals arkanite and aphtalose are also largely made up of these sulphates, but have a smaller proportion of potassium sulphate, reaching a value as low as 62 per cent. It is now shown that these minerals do not contain definite double sulphates, but are the limiting members of an isomorphous series of hexagonal crystals in which the angle (1011) : (0001) varies continuously from 56° 7′ in glaserite to 59° 31′ in arkanite.

In a similar manner it is shown that astrakanite, which has the formula $MgNa_2(SO_4)_2 . 4H_2O$, may contain 1 per cent. K_2SO_4, whilst leonite, MgK_2

$(SO_4)_2 . 4H_2O$, may contain very large amounts of sodium sulphate, the limit being approximately represented by the formula $MgSO_4$, $0{\cdot}76K_2SO_4$, $0{\cdot}24Na_2SO_4$, $4H_2O$. They are thus partially miscible, but do not form a complete isomorphous series. It is proposed to abandon the term astrakanite since its identity with simonyite has been proved.

Finally a modified scheme is given for the equilibrium at 25° of the various salts which occur in oceanic salt-deposits, and the changes that have been rendered necessary by the discovery of isomorphism are pointed out. [See also Abstracts Nos. 133 and 936 (1903).] T. M. L.

410. *Oceanic Salt-deposits.* XXXI. *Lower Temperature-limit of Formation of Vanthoffite at* 46°. **J. H. van't Hoff** and **G. Just**. (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 24. pp. 499–503, April 23–30, 1903.)—Loeweite, prepared by evaporating a solution of sodium and magnesium chlorides and magnesium sulphate at 55–60° until it began to deposit crystals of astrakanite, $MgNa_2(SO_4)_2$, $4H_2O$, and then sowing with loeweite and digesting in a closed vessel at the same temperature, has the composition given by the formula $Mg_2Na_4(SO_4)_4$, $5H_2O$ suggested by Tschermak, and not the formula $MgNa_2(SO_4)_2$, $2H_2O$ suggested by O'Farelly. It may be regarded as a partially dehydrated astrakanite, whilst vanthoffite, $MgNa_6(SO_4)_4$, results from the replacement in astrakanite of $4H_2O$ by $2Na_2SO_4$. The conversion of astrakanite into vanthoffite is not readily effected in presence of sodium sulphate only, but in a solution saturated with sodium chloride, astrakanite, and sodium sulphate, the transition temperature above which vanthoffite begins to be formed was found (by means of the tensimeter) to lie at 48–49°, whilst in a solution saturated with sodium chloride, sodium sulphate, glaserite and astrakanite, the transition temperature was lowered to 46°. This last solution is substantially identical with that from which natural vanthoffite was deposited, and 46° is the minimum temperature at which it can have been formed. Above 59° the astrakanite is unstable. In contact with a solution saturated with sodium chloride, sodium sulphate, and glaserite (and therefore supersaturated with regard to vanthoffite, which does not readily crystallise out from the solution), the upper temperature limit at which astrakanite is stable is 58–59°, whilst in a solution saturated with vanthoffite (the stable solid phase above 46°) instead of sodium sulphate, the transition temperature is half a degree higher. [See also preceding Abstract.] T. M. L.

411. *Ozone as an Oxidising Agent.* **R. Luther** and **J. K. H. Inglis.** (Zeitschr. Phys. Chem. 43. pp. 203–238, April 3, 1903.)—A careful electrochemical (e.m.f.'s) study of ozone. The chief results are: (1) Dissolved ozone acts electromotively as a strong oxidiser, oxygen being the primary product. (2) The e.m.f. of a platinum-ozone electrode is given by the equation $\pi(Pt, O_3) - \pi(\text{solution}) = \pi_0 + \frac{RT}{F} \log (C_{O_3} \times C_H)$. (3) The e.m.f. of an ozone-hydrogen gas cell is given by $\pi(Pt, O_3) - \pi(Pt, H_2) = 1{\cdot}861 + 0{\cdot}054 \log_{10} C_{O_3}$, where π is measured in volts and C_{O_3} in mols. per litre. (4) Ozone in acid solution liberates from neutral KI solution 3 equivalents of iodine per mol. of ozone; if both solutions neutral, 2 equivalents per mol. of ozone. (5) Ozone in acid solution oxidises 2 mols. of ferrous salt to ferric, per mol. of ozone.

F. G. D.

412. *Attempt to Explain Physically the Periodicity of the Elements.* **A. J. Batschinski.** (Zeitschr. Phys. Chem. 43. pp. 372–375, April 9, 1903.)—The

author maintains that the atoms are in a state of vibration and that their properties are characterised by the period of this vibration. From analogy with the pendulum equation $T = \pi\sqrt{\frac{m}{g}}$, the period (T) is taken as proportional to the square root of the atomic wt. (*m*). Between these square roots therefore the author expects simple harmonic relations, and finds them (in the case of related elements). Concerning these reference must be made to the original paper. F. G. D.

413. *Recent Advances in Stereochemistry.* **W. J. Pope.** (Roy. Inst., Proc. pp. 1–15, May 1, 1903.)—A review of recent investigations in stereochemistry and especially of the experiments which have led to the discovery of optically active compounds containing asymmetric nitrogen, sulphur, selenium, and tin, in place of the usual asymmetric carbon atom. The lecture concludes with a description of the part played by optical isomerism in physiological processes; all the natural food-stuffs are optically active and occur in only one of the possible enantiomorphous forms, the albumins being all lævorotatory and the starches and sugars dextro-rotatory; *l*-glucose, prepared synthetically by E. Fischer, is not fermentable, and probably could not be digested; a diet of opposite optical activity would therefore in all probability result in starvation. Speculating on the origin of optical activity it is suggested that natural selection would favour the development of optically active organisms, in order to avoid duplicating the mechanism of vital processes, and that the predominance of one or other form would be determined by some slight accidental advantage, just as accident rather than design appears to have determined the "rule of the road" in different countries. T. M. L.

414. *Velocity of Conversion of Carbonmonoxide.* **A. Smits** and **L. K. Wolff.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 34–41, May 30, 1903.)—The velocity of conversion of CO into CO_2 and C is shown to be *monomolecular* at all the temperatures investigated by the author, viz., 256°, 310°, 340°, and 445°. The reaction is found to be reversible, as opposed to Boudouard's results obtained at a temperature of 445° [see Abstracts Nos. 661 and 2429 (1901)]. The authors were unable to determine the equilibrium constant, as different values were obtained for K, according as the start was made from CO or from $CO_2 + C$. A. G.

415. *Intermolecular Transpositions.* **C. L. Jungius.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 161–166, June 27, 1903.)—In this paper, the reciprocal conversion of the two stereo-isomeric methyl-*d*-glucoisides is examined, the following results being obtained: Starting from pure *α*-methyl glucoside on the one hand, and pure *β*-methyl glucoside on the other, the methyl-alcoholic solution containing HCl will in both cases attain the same state of equilibrium in which the *α*- and *β*-compounds are both present. Removing HCl will leave a crystalline mass which, on evaporation with acid ether, leaves a very small amount of a non-crystallisable product, which the author thinks is possibly Fischer's dimethyl acetal. A. G.

416. *Determining Neutralisation Points by Conductivity Measurements.* **F. W. Küster** and **M. Grüters.** (Zeitschr. Anorg. Chem. 35. 4. pp. 454–460, July 8, 1903.)—These experiments show that whenever the use of

colourimetric indicators is impossible on account of deposits or colourations, the neutralisation-point is readily noticed and perfectly defined by means of conductivity measurements. Solutions adjusted with an indicator for hydroxyl ions (phenolphtalene) fail to give perfectly true results in the case of an indicator for hydrogen ions (methyl orange) being used, the deviations depending on the concentration (the volume) and the presence of neutral salts (sodium chloride, &c.). With phenolphtalene as an indicator, baryta water only should be used for accurate titrations, for sodium and potassium hydroxides, on account of their variable percentage in carbonate, give deviations depending in an uncontrollable way on accidental circumstances. In solutions devoid of carbonate, phenolphtalene will give transitions practically coinciding with the true neutral point. Methyl orange is less sensitive, its sensitiveness varying under the influence of different factors. A. G.

417. *Reactions between Yellow Phosphorus and Copper.* **W. Straub.** (Zeitschr. Anorg. Chem. 35. 4. pp. 460–474, July 8, 1903.)—Experiments on the system $P + Cu + H_2O + O_2$, with a view to investigate the oxidation of phosphorus, have shown that the quantity of copper phosphide once formed will suffice to feed this reaction until it is completed, no matter whether the phosphide is produced by reducing the phosphate or sulphate. This process is only susceptible of being realised in practice with dilute solutions. The concentration may be maintained constant by phosphorus present in excess in the solvent. If, however, the phosphorus be present in the solid state, the deposit of phosphide, and eventually of metallic copper, will hinder the oxidation of the phosphorus, this then occurring at a much lower rate. This obstacle, however, is purely mechanical, causing no change in the general character of the process. The system $P + CuSO_4 + H_2O$ is therefore only a special case of the system $P + Cu + H_2O + O_2$, differing from the latter by the copper salt charged with oxygen being present in excess at the very beginning. The oxidation of phosphorus in the first-named system occurs at a higher rate than with the system P (in dilute solution) $+ Cu + H_2O + O_2$. If in the first-named system all the copper present in solution in the oxidised state be reduced, the oxidation is stopped, but recommences as soon as atmospheric oxygen is allowed to enter. A. G.

418. *Contributions to the Knowledge of Metaphosphates.* **F. Warschauer.** (Zeitschr. Anorg. Chem. 36. 2. pp. 137–201, Aug. 15, 1903.)—The author regards Fleitmann's dimetaphosphates, on the Ostwald-Walden valency rule, as tetrametaphosphates, a determination of the transport numbers of the sodium salt confirming the determined values of the conductivity. When phosphoric acid is heated with lead oxide, two different metaphosphates are obtained according to the degree of heating. The first, produced by heating up to 400°, contains metaphosphoric acid in the same modification as tetrametaphosphates. The second salt, produced by heating to temperatures above 400° and subsequent melting, will yield by reaction with sodium sulphide a soluble salt, showing as to its physical behaviour, its reactions, and the values of its electric conductivity, the closest agreement with the salt so far termed hexametaphosphate. A. G.

419. *Rigorous Separation of the Rare Earths.* **G. Urbain** and **H. Lacombe.** (Comptes Rendus, 137. pp. 792–794, Nov. 16, 1903.)—For the

separation of isomorphous salts of two rare metals, A and B, the authors introduce into the solution an isomorphous salt of a third metal, C. This third metal is a common one, and can be easily removed when desired. A series of crystalline fractions is next obtained; this series at one end consists of different mixtures of A and C, at the other end of similar mixtures of B and C. On removal of C, A and B are easily obtained pure. Samarium and gadolinium were thus successfully separated. D. H. J.

420. *History of the Water Problem.* **J. W. Mellor.** (Journ. Phys. Chem. 7. pp. 557–567, Nov., 1903.)—An article touching briefly on the various theories of combustion from the time of Becker (1669), and with the catalytic action of water in promoting combustion. It is mainly taken up with extracts from an essay by a Mrs. Fulhame, to which attention is called ("An Essay on Combustion with a view to a New Art of Dying and Painting, wherein the phlogistic and antiphlogistic hypotheses are proved erroneous." London, 1794). These extracts cite experimental evidence, and show that the presence of water or water vapour as a catalyser is essential in the reduction of metallic salts and oxides by means of the common reducing agents, including light. J. D. C.

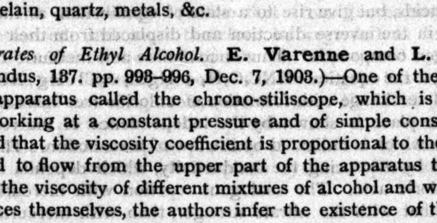
421. *Transformation of Diphenylnitrosamine into* p-*Nitrosodiphenylamine, and its Velocity.* **H. Raken.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 267–269, Nov. 25, 1903.)—The above reaction is found to be of the first order, the reaction constant being proportional to the concentration of the hydrochloric acid which gives rise to the conversion. In absolute ethyl alcohol at 35° the following values of k were found: 1 mol. HCl, $k = 0{\cdot}0081$, 2 mols. HCl, 0·018, 3 mols. HCl, 0·026. On adding water, the reaction constant is found to decrease considerably, the water evidently eliminating part of the hydrochloric acid from the reaction, rendering the same less active. The temperature coefficient is found to be very high, being upwards of 5 for each 10°. The general conclusion is drawn that the conversion of nitroso-amines into nitroso-bases is a real intermolecular transposition of atoms. As regards the possible existence of an intermediate product, the author hopes to discuss this point later on and give particulars as to the working of other catalysers and the influence of other solvents on the transposition. A. G.

422. *Slow Combustion of Methane and Ethane.* **W. A. Bone.** (Chem. News, 88. pp. 283–284, Dec. 11, 1903. Paper read before the Brit. Assoc., Section B., at Southport, 1903.)—The author's investigations show that when mixtures of methane (or ethane), with just sufficient oxygen to burn the carbon to carbon monoxide, are heated in sealed bulbs of boro-silicate glass at temperatures far below the explosive ignition-points, a portion of the hydrocarbon is slowly burnt finally to CO, CO_2 and steam, whilst a certain amount remains intact. There is never any liberation of free hydrogen or free carbon. The old idea of "preferential combustion" is thus seen to be false. Experiments carried out in an apparatus which provides not only for continuous circulation of the gases, but also for the removal of soluble or condensable intermediate products by suitable washers, have demonstrated the important fact that formaldehyde occurs as an intermediate product in the case of methane; acetaldehyde and formaldehyde in the case of ethane. On these facts as a basis the author builds up a tentative theory of the mechanism of these slow oxidations. F. G. D.

423. *Accelerating and Retarding Influences acting on Manganese regarded as a Metallic Ferment.* **A. Trillat.** (Comptes Rendus, 137. pp. 922–924, Nov. 30, 1903.)—The author has studied the effect of manganese salts in different media, in altering the velocity of oxidation of gallic acid and other similar substances by oxygen. In order that the manganese shall exert an accelerating action, the solution must be alkaline, and the acceleration is proportional to the amount of alkali. For a given quantity of alkali, increase in the amount of manganese first accelerates and then retards the oxidation, the amount of manganese necessary to cause appreciable acceleration being very small. The oxidation can be affected very markedly by various substances—porcelain, quartz, metals, &c. A. F.

424. *Hydrates of Ethyl Alcohol.* **E. Varenne** and **L. Godefroy.** (Comptes Rendus, 137. pp. 993–996, Dec. 7, 1903.)—One of the authors has devised an apparatus called the chrono-stiliscope, which is a capillary viscometer working at a constant pressure and of simple construction. It is so arranged that the viscosity coefficient is proportional to the time taken for the liquid to flow from the upper part of the apparatus to the lower. Investigating the viscosity of different mixtures of alcohol and water, and the pure substances themselves, the authors infer the existence of the following five hydrates: C_2H_5OH, 2 aq; C_2H_5OH, 3 aq; C_2H_5OH, 6 aq; $3C_2H_5OH$, 2 aq (sesquihydrate); C_2H_5OH, 22 aq. F. S.

425. *Meteoric Iron.* **F. Osmond** and **G. Cartaud.** (Comptes Rendus, 137. pp. 1057–1059, Dec. 14, 1903.)—The temperature at which the magnetic transformation of iron-nickel alloys takes place is represented by the curves of Figs. 1 and 2, of which the former represents the transition-temperatures observed on cooling, and the latter those observed on heating the alloys. Alloys having a composition from O to E yield unsaturated solutions of nickel in α-iron, and are identical with the *kamacite* of meteoric iron; alloys richer in nickel than F yield unsaturated solid solutions of iron in α-nickel and are identical with the *taenite* of meteoric iron; alloys containing proportions of nickel between OE and OF yield mixtures of the two saturated solid solutions of the composition OE and OF; such a mixture occurs in meteoric iron as *plessite*, which is to be regarded as the eutectic alloy of kamacite and plessite. T. M. L.



426. *Preparation of Anhydrous Crystalline Fluorides.* **Defačqz.** (Comptes Rendus, 137. pp. 1251–1253, Dec. 28, 1903.)—Crystalline calcium fluoride can be prepared by fusing manganese fluoride with calcium chloride; when heated at 800–1000° the fluoride crystallises in octahedra, but after heating at 1200–1400°, in perfect cubes. It is soluble in fused calcium chloride and in a mixture of calcium and manganese chlorides, but if there is any large proportion of manganese chloride it is partially decomposed according to the equation $CaF_2 + MnCl_2 \rightleftarrows MnF_2 + CaCl_2$. T. M. L.

427. *Dissociation of Salts of the Heavy Metals. I. Nitrogenous Mercury Salts.* **H. Ley** and **K. Schaefer.** (Zeitschr. Phys. Chem. 42. pp. 690–704, March 3, 1903.)—Mercury salts of nitrogenous compounds, containing mercury directly united with the nitrogen, are very slightly dissociated. Consequently nitrogenous compounds of weak acids do not react completely with strong acids, but give rise to a state of equilibrium, as the strong acids are acted on in the inverse direction and displaced from their mercury salts by the nitrogen compounds. Thus succinimide and mercuric chloride interact according to the equation: $HNC_4O_2H_4 + HgCl_2 = Cl . Hg . NC_4O_2H_4 + HCl$. That a complete change with formation of chlorine-free mercurisuccinamide does not take place is shown by the independence of the reaction on the concentration which is indicated by the law of mass action. The equilibrium is determined by measuring the conductivity, which depends mainly on the free hydrochloric acid. The analogous reaction with mercuric bromide is weaker, and that with the nitrate stronger, than with mercuric chloride, as would be expected from the relative dissociations of the three salts. Rise of temperature is without appreciable influence on the equilibrium. In a similar way, the authors investigate the influence of mercuric chloride or other acid amides, especially urea, urethane and biuret, and also succinimide and the imide of camphoric acid. With the imides, the union of the mercury with nitrogen is even stronger than with the amides, so that the dissociation of the mercury compounds is less, and their formation from mercuric chloride more free. Mercuric cyanide is only slightly decomposed by hydrochloric acid, and not at all by nitric acid. The authors are of opinion that in mercuric cyanide the mercury is combined directly with carbon, and that this combination is even more stable than that with nitrogen. T. H. P.

428. *Researches on the Concatenation* (Koppelung) *of Chemical Reactions.* **N. Schilow.** (Zeitschr. Phys. Chem. 42. pp. 641–689, March 3, 1903.)—Induced by the publications of Manchot and Schaer, the author gives a preliminary account of his researches on the phenomena originally studied by Kessler in 1855, and named by the latter "chemical induction." A special class of these phenomena has been recently investigated under the name of "oxygen-activation" by Engler, van't Hoff and Jörissen, Haber, Bodländer, &c., &c. The author defines the subject of his research by referring it to Ostwald's category of "coupled" (concatenated?) reactions. The characteristic of this group is that *a "slow" reaction between two substances is accelerated by the simultaneous reaction of one of them with a third substance* (Kessler's chemical induction). The meaning of this and the technical nomenclature now employed can be best explained by an example. (1) Bromic acid ("actor") does not oxidise arsenious acid (*i.e.*, with practically negligible velocity). (2) Bromic acid oxidises sulphurous acid almost instantaneously. (3) If one adds sulphurous acid to a mixture of arsenious and bromic acids, not only is the sulphurous acid ("inductor") oxidised, but a part also of the arsenious acid ("acceptor"). The paper contains the results of a scientific investigation of many such cases, *e.g.*, Fehling's solution + oxidiser; ammonia + hypochlorite + oxidiser; oxyacid + chromic acid + arsenious acid; oxyacid + $KMnO_4$ + reducer; oxyacid + chromic acid

+ sulphurous acid; bromic acid + arsenious acid + sulphurous acid; bromic acid + chromic acid + arsenious acid; bromic acid + arsenious acid + hydrobromic acid (case of self-induction). F. G. D.

429. *Heterogeneity of Colloidal Solutions.* **G. Bredig.** (Ann. d. Physik, 11. 1. pp. 218–222, April, 1903.)—The view that colloidal "solutions" are two-phase systems or suspensions rather than solutions is supported by the following facts: (1) A colloidal "solution" of ferric hydroxide in which no separate particles can be detected under the microscope exhibits Tyndall's phenomenon, *i.e.*, an incident beam of light is very widely scattered in the "solution," and the diffused light (unlike that from fluorescent crystalloid solutions) is polarised, and must therefore be regarded as having been reflected. (2) Colloidal solutions of metals can be prepared electrically at a metallic kathode, and the heterogeneity of colloidal gold has been demonstrated by Siedentopf and Zsigmondy [see Abstract No. 1169 (1903)], who have rendered the particles visible by diffraction and measured their diameter. (3) The constant vapour pressure of solutions of widely different concentrations is characteristic of two-phase systems. [See also Abstract No. 1289 (1903).] T. M. L.

430. *Decomposition Curves of Copper Salt Solutions.* **E. Abel.** (Zeitschr. Elektrochem. 9. pp. 268–269, April 2, 1903.)—The decomposition curves for cupric salts show a slight break at a lower voltage than that normally required for the deposition of copper from a cupric salt [see Abstract No. 1519 (1903).] This was explained by Heiberg as being due to supersaturation of the solution with cuprous ions, but it is now suggested that it is due to the conversion of cupric to cuprous ions, with liberation of a positive charge, at a lower voltage than that required to reduce cupric ions to metallic copper. T. M. L.

431. *State of Some Per-acids and their Salts in Solution.* **L. Pissarjewsky.** (Zeitschr. Phys. Chem. 43. pp. 160–172, April 3, 1903.)—Sodium peruranate, Na_4UO_8, is the sodium salt of a weak acid which can be formulated as $UO(OH)(.O.OH)_3$, and is hydrolysed in solution to NaOH and H_2O_2, the action being reversible. On allowing the solution to stand (when the hydrogen peroxide presumably decomposes) peruranic acid $UO(OH)_3(.O.OH)$, containing only one peroxidised radicle, is produced and separates from the solution. Hydrogen peroxide can be extracted from the alkaline solution by means of ether, and from the concentration of the peroxide in the ethereal extract, the amount of *free* hydrogen peroxide in the aqueous solution can be determined. Similar experiments on the distribution of hydrogen peroxide between the aqueous and ethereal layers showed that pertungstic acid, $WO_2(OH)(O.OH)$ exists in solution also as $WO_2(O.OH)_2$, but that both these acids are partially hydrolysed to hydrogen peroxide. As the result of a series of conductivity measurements, it is suggested that of the two known pervanadates one, KVO_4, is actually the salt of a monobasic acid, whilst the other, which has the composition $K_8V_5O_{26}$, is regarded as a double salt of $4KVO_4$ with the potassium salt of a tetrabasic pyropervanadic acid. An aqueous solution of sodium perborate contains sodium borate, caustic soda, sodium peroxide, boric acid, hydrogen peroxide, and probably only traces of actual sodium perborate; but at lower temperatures the proportion of perborate increases, and at 0° it appears to be the only compound present in the solution. [See also Abstract No. 506 (1903).] T. M. L.

432. *Pervanadic Acid.* **L. Pissarjewsky.** (Zeitschr. Phys. Chem. 48. pp. 173–178, April 3, 1903.)—Vanadium pentoxide when shaken with aqueous hydrogen peroxide dissolves as a red pervanadic acid—

$$V_2O_5 + 2H_2O_2 = 2HVO_4 + H_2O.$$

The solution decomposes on standing, liberating oxygen and yielding vanadic acid, HVO_3 (or $H_2V_4O_{11}$, or $H_2V_6O_{16}$), which is also formed by the action of hydrogen peroxide on an excess of V_2O_5. T. M. L.

433. *Molecular State of Borax in Solution.* **H. S. Shelton.** (Zeitschr. Phys. Chem. 42. pp. 494–498, April 21, 1903.)—A solution of NaOH of N/20 strength was gradually diluted with an N/20 solution of $(NaOH + 4H_3BO_3)$ and the conductivity measured from time to time. There was a rapid decrease of conductivity as the caustic soda was neutralised, and this continued until acid and base were present in the ratio $NaOH : H_3BO_3$; further addition of the acid solution caused only a slight decrease of conductivity. Boric acid (which in the free state has an almost negligible conductivity) thus behaves primarily as a monobasic acid, and yields in solution the salt NaH_2BO_3 and the ions $\overset{+}{Na}$ and $\overset{-}{H_2BO_3}$, or the salt $NaBO_2$ and the ions $\overset{+}{Na}$ and $\overset{-}{BO_2}$. It is not possible to decide between these formulæ, but it is pointed out that (1) no stable orthoborates are known derived from H_3BO_3, whilst metaborates derived from HBO_2 are known, including sodium metaborate; (2) the precipitation of borax by silver nitrate yields silver metaborate, $AgBO_2$. T. M. L.

434. *Behaviour of Ions in Solution.* **C. A. L. de Bruyn.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 159–161, June 27, 1903.)—H. Jahn some time ago developed a theory [see Abstracts Nos. 183 and 2211 (1901)] in which the departures in the behaviour of strongly dissociated electrolytes from Ostwald's law of dilution were accounted for by the hypothesis of a reciprocal action of the ions, whereas Nernst [see Abstract No. 1878 (1900)] presumes, in addition, an action between the ions and the non-dissociated molecules. The author investigates the question as to whether the ions exert on the molecules of the solvent an effect resulting in the solvent being carried along in the electrolysis. Experiments made with similar mixtures as solvent, and cupric chloride and silver nitrate as electrolytes in an apparatus for determining the transport numbers of ions, show beyond doubt that the solvent is not carried along by the ions. A. G.

435. *Mercury Alloys.* **N. A. Puschin.** (Zeitschr. Anorg. Chem. 36. 2. pp. 201–255, Aug. 15, 1903.)—Recent experiments have shown the amalgams of alkali metals to represent a series of well-defined chemical compounds. The present paper treats of mercury alloys with heavy metals, three methods being subsequently used, viz.—(1) determining the melting curves; (2) investigating the microstructure; (3) determining the electromotive forces. From the experiments it is inferred that the melting curves of mercury alloys with Bi, Zn, Pb, and Cd, so far from pointing to the existence of any definite chemical compounds between mercury and other metals, go to show that mercury does not form any definite chemical compound, but only mechanical mixtures with Zn or Bi, and solid solutions with cadmium, lead, or tin [see Abstract No. 1149 (1902)]. Similar conclusions are drawn from an investiga-

tion into the electromotive forces of such alloys, and in the case of Cu it is shown that even in considerable dilution with mercury (0·4 parts of Cu by 99·6 parts Hg), the metallic character is fully preserved. As regards the microstructure of mercury alloys, it is shown that the structure of mercury alloys with Zn, Pb, Bi, Cd, and Sn is very much the same as the structure of pure metals. The author therefore thinks he is warranted in concluding that the amalgams of heavy metals correspond to the formation of solid solutions or isomorphous mixtures, the hypothesis of the existence of definite chemical compounds not being borne out by experiment. A. G.

436. *Solution of Gold in Hydrochloric Acid.* **N. D. Averkieff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7. p. 714, 1903.) Paper read before the Russian Physico-Chemical Society (Chemistry Section), Sept. 24, 1903.)—The author observed that when hydrochloric acid is placed in contact with metallic gold in the presence of formaldehyde, trioxymethyl, methyl, ethyl, and amyl alcohols, and also phenol, chloroform, and several other organic bodies, dissolution of the gold will take place. The solutions obtained in this way, on being vaporised, dried, and heated, leave a residuum of metallic gold. A. G.

437. *Benzidine Reaction.* **A. F. Holleman** and **J. Potter van Loon.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 348–353, Sept. 26, 1903.) —In a previous communication on the same subject [see Abstract No. 595 (1903)] the author related how he had succeeded in obtaining both benzidine and hydrazobenzol in the absolutely pure state. Tables of the ratio in which benzidine and diphenyline are produced through the conversion of hydrazobenzol by acids show that, using either water or 50 per cent. alcohol as a solvent, the amount of benzidine will first augment for some time with increasing concentration of the hydrochloric acid and decrease later on. As regards the influence of the kind of acid used, the figures recorded do not differ materially, apart from sulphuric acid, for which higher values are obtained. The influence of temperature is the same with either solvent, being a decrease in the ratio of conversion with increasing temperature. The rate of conversion was next determined, the equation $d\mathrm{Cb}/dt = \mathrm{KC}^2\mathrm{HCl}$ representing the behaviour of the conversion, t being the time (in minutes) and K the reaction constant. The conversion is due to the hydrogen ions of the acids, as shown by the proportionality of the reaction constant to the degree of ionisation of the acids used. A. G.

438. *Influence of Temperature on the Dissolution of Some Substances in Sulphurous Anhydride.* **G. Centnerszwer** and **J. Teletoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. No. 7a. p. 718, 1903.) Paper read before the Russian Physico-Chemical Society, Sept. 24, 1903.)—The authors investigate the solubility of anthracene, anthrachinone, and hydrochinone in SO_2, up to and even beyond the critical point of the solvent. The curve of solubility is found in this case not to cross the critical curve. For anthrachinone the influence of the more or less filled state of the vessel on the average solubility is, in addition, studied. Phenomena are described, observed when tubes with extremely dilute liquids were heated, and a method suggested for determining the solubility of almost non-volatile liquids in saturated steam and in the liquid under the pressure of saturated steam. [See also Abstracts Nos. 752 and 1478 (1903).] A. G.

439. *Solubility of Calcium Sulphate in Aqueous Solutions of Sulphuric Acid.* **F. K. Cameron** and **J. F. Breazeale.** (Journ. Phys. Chem. 7. pp. 571–577, Nov., 1903.)—The addition of sulphuric acid at first increases and then decreases the solubility of calcium sulphate in water. At 25° the solubility increases from 2·126 to 2·841 g. per litre on introducing 75 g. H_2SO_4 per litre, and then decreases to 1·541 g. in presence of 292 g. H_2SO_4 per litre. At 35° the maximum is at 3·70 g. in presence of 85 g. H_2SO_4 per litre, and at 43° at 4·26 g. in presence of 105 g. H_2SO_4 per litre. The solubility in pure water only increases by 1 per cent. between 25° and 43°, but the influence of the acid is greatly increased as the temperature rises, and the solubility in 7·5 per cent. sulphuric acid increases 46 per cent. between these temperature limits. The increase of solubility of $CaSO_4$ by H_2SO_4 is contrary to the effect observed in cases such as the precipitation of NaCl by HCl, and appears to indicate that they do not yield the same ion or that an acid salt is produced. The solvent appears to undergo contraction in preparing the solutions, and the solution-volumes are negative; thus a litre of water at 25° C. weighs 997·12 g., but the litre of solution containing 0·49 g. H_2SO_4 and 2·128 g. $CaSO_4$ weighs 1002·493 g. and actually contains 999·875 g. water. T. M. L.

440. *Solubility of Magnesium Carbonate in Aqueous Solutions of Certain Electrolytes.* **F. K. Cameron** and **A. Seidell.** (Journ. Phys. Chem. 7. pp. 578–590, Nov., 1903.)—The solubility of magnesium carbonate is much influenced by the proportion of carbon dioxide in the gaseous phase; if this is large it is very difficult to get exact results. In an atmosphere free from carbon dioxide the solubility of $MgCO_3$ in aqueous salt solutions at 23° increases from 0·176 g. per litre to a maximum at 0·585 g. per litre in presence of 106·3 g. NaCl, and decreases again to 0·293 g. in presence of 331·4 g. NaCl per litre. In presence of atmospheric air the maximum is at 0·8 g. $MgCO_3$ in presence of 105 g. NaCl. In an atmosphere of carbon dioxide the addition of salt causes a steady decrease in solubility from 30·6 to 10·75 g. $Mg(HCO_3)_2$ in presence of 306·6 g. NaCl per litre. In an atmosphere free from carbon dioxide sodium sulphate up to 300 g. per litre caused an increase in the solubility of magnesium carbonate which was greater at 23° than at 35·5°, and more rapid at small than at great concentrations; sodium carbonate causes an increase of solubility which is slight at first but rises rapidly according to an approximately linear law at concentrations from 50 to 200 g. Na_2CO_3 per litre. The results do not confirm to the general rule that the addition of a salt having a common ion causes a decrease of solubility, whilst other salts cause an increase. T. M. L.

441. *Colouration of Methylorange by Acids.* **P. Vaillant.** (Comptes Rendus, 137. pp. 849–851, Nov. 23, 1903.)—The author criticises the theories of Ostwald and Küster on the red colouration. The former supposes that the anion is yellow, and that methylorange is red. If this were so, dilution which causes dissociation would cause methylorange to turn continuously to yellow. On the other hand, Küster's theory [which supposes the formation, on dilution, of neutral ions (nichtionen) $H—N(CH_3)_2—C_6H_4—N_2—C_6H_4—SO_3$, which are red in colour, at the expense of the anions $N(CH_3)_2—C_6H_4—N_2—C_6H_4—SO_3$] would indicate an increasing tendency towards red on dilution. Experiments of Gouy with aqueous methylorange show that its molecular absorption, for rays 550 $\mu\mu$, 546 $\mu\mu$, and 542 $\mu\mu$, is independent of the concentration—a fact opposing both the above theories; and that its molecular conductivity increases with dilution, which is against the idea of the formation of "nichtionen" which take no part in conduction. One must then suppose that aqueous solutions of methylorange only contain complete and dissociated molecules of the same yellow colour, neither of which can alone account for the change produced by acids. This change must then be an actual molecular transformation of the methylorange. In support of this the author cites the formation of red crystals on the evaporation of an alcoholic solution of methylorange treated with hydrochloric acid.

J. D. C.

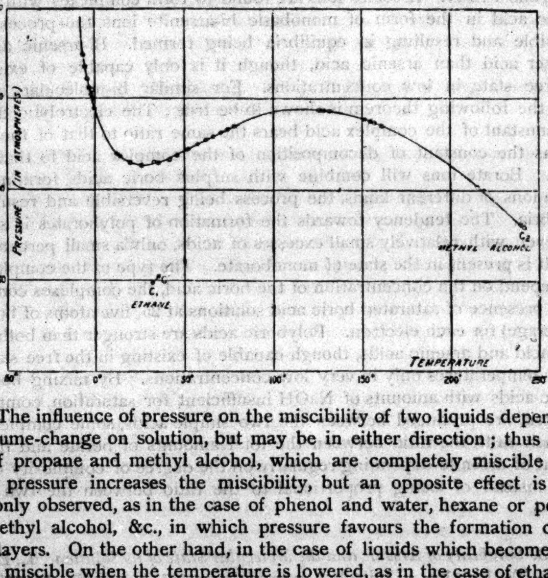
442. *Complexes of Boric and Arsenic Acids.* **F. Auerbach.** (Zeitschr. Anorg. Chem. 37. 3. pp. 353–378, Nov. 30, 1903.)—Arsenic acid is shown to be soluble in amyl alcohol, being distributed between this and water in the constant ratio 1 : 5·47. Arsenite ions are found to form complexes with surplus arsenic acid in the form of monobasic bi-arsenite ions, the process being reversible and resulting in equilibria being formed. Bi-arsenic acid is a stronger acid than arsenic acid, though it is only capable of existing in the free state in low concentrations. For similar bi-molecular complex acids the following theorem is shown to be true: The electrolytic dissociation constant of the complex acid bears the same ratio to that of the simple acid as the constant of decomposition of the complex acid to that of the anion. Borate ions will combine with surplus boric acids, forming polyborate ions of different kinds, the process being reversible and resulting in equilibria. The tendency towards the formation of polyborates is so great that, even with relatively small excesses of acids, only a small percentage of the salt is present in the state of monoborate. The type of the complex form will depend on the concentration of the boric acid, the complexes containing in the presence of saturated boric acid solutions at 25° five atoms of boron (as an average) for each electron. Polyboric acids are stronger than both monoboric acid and arsenic acids, though capable of existing in the free state and at low temperatures only in very low concentrations. By mixing boric and arsenic acids with amounts of NaOH insufficient for saturation, complicated equilibria are produced between the two simple acids, some complex acids and their salts, the ratio between the total amounts of borate and the total amount of arsenite depending regularly on the degree of complexity of both acids, instead of being proportional to the ratio between the two simple acids.

A. G.

443. *Solubility of Arsenic and the Molecular State of its Solution.* **L. Bruner** and **S. Tolloczko.** (Zeitschr. Anorg. Chem. 37. 3. pp. 455–459, Nov. 30, 1903.)—In the course of an investigation into the rate of dissolution of solid bodies [see Abstract No. 943 (1903)], an apparatus ensuring a most active stirring of the mixture was used. This apparatus was used to measure the solubility of arsenic at different temperatures. This dissolution, as recently shown, takes place with extraordinary slowness on account, most probably, of the hydratation occurring. The solubility of arsenic, as shown by the authors, is not proportional to the temperature. The molecular heat of solution is found by calculation to be about — 4,000 calories. As the value found by calorimetric determination is about twice this, the authors conclude that the molecular weight of arsenic acid in aqueous solutions is half As_2O_3 instead of As_2O_3; in other words, the acid produced by hydratation of As_2O_3 in aqueous solution will contain not *two* but *one* equivalent weight of arsenic. This is in accord with the recent results of J. Zawidzki (Ber. Deutsch. Chem. Ges. 36, p. 1427).

A. G

444. *Mutual Solubility of Liquids.* **J. P. Kuenen.** (Phil. Mag. 6. pp. 637–653, Dec., 1903.)—The influence of ethane on the critical temperature and pressure of methyl alcohol was determined, and is represented by the accompanying curve. Experiments were also made on the miscibility of methyl alcohol with ethane, propane, pentane, and hexane, of ethyl alcohol with hexane, of carbon disulphide with methyl, ethyl, propyl and butyl alcohols, and of water with diethylamine and triethylamine. The observations made were all confirmatory of Lehfeldt's observations that the occurrence of two liquid phases is dependent on the abnormality (polymerisation) of one of the components; thus the two layers formed by a hydrocarbon and alcohol become completely miscible at a lower temperature on ascending the series of alcohols, corresponding with a decreasing coefficient of association. The influence of pressure on the miscibility of two liquids depends on the volume-change on solution, but may be in either direction; thus in the case of propane and methyl alcohol, which are completely miscible above 21·15°, pressure increases the miscibility, but an opposite effect is more commonly observed, as in the case of phenol and water, hexane or pentane and methyl alcohol, &c., in which pressure favours the formation of two liquid layers. On the other hand, in the case of liquids which become completely miscible when the temperature is lowered, as in the case of ethane, or ethyl or propyl alcohol, triethylamine and water, &c., pressure appears always to favour miscibility, and no example has been found in which the opposite effect is produced. [See also Abstract No. 1220 (1899).]



T. M. L.

445. *Action of Carbon Dioxide on Aqueous Solution of Aniline in Presence of Nitrites.* **L. Meunier.** (Comptes Rendus, 137. pp. 1264–1266, Dec. 28, 1903.)—Some diazoamidobenzene is formed. The author's explanation is that aniline carbonate is formed, which reacts with the nitrite to give aniline nitrite. This then loses water and gives $C_6H_5 . N = N - OH$, which combines with free aniline to give diazoamidobenzene, $C_6H_5 . N = N . NH . C_6H_5$. It is shown that none of this body is formed if nitrite is present without carbonic acid, contrary to the results obtained by Niementowski and Rozskowski (Z. Phys. Chem. 22, 1897, p. 45).

F. G. D.

446. *Electric Osmose in Liquid Ammonia.* **M. Ascoli.** (Comptes Rendus, 137. pp. 1253–1255, Dec. 28, 1903.)—Using a membrane of porous alumina, it was found that the application of an electromotive force caused a very slight displacement of liquid ammonia through the membrane in the direction of the current, but the conducting solution which is formed on dissolving metallic sodium in ammonia was displaced to a very considerable extent, and in the opposite direction to that of the current. T. M. L.

447. *Dissociation of Alkaline Carbonates.* **P. Lebeau.** (Comptes Rendus, 137. pp. 1255–1257, Dec. 28, 1903.)—In extension of his previous work on the dissociation of lithium carbonate, the author has determined the dissociation pressures of the carbonates of sodium, potassium, rubidium, and cæsium. In all cases it was found that slightly different values of pressure were obtained with falling temperature from those with rising temperature, owing to the formation of a volatile alkaline oxide, which condensed on the colder parts of the tube and absorbed a certain amount of the carbon dioxide formed. The values of dissociation pressure found are as follows:—

SODIUM CARBONATE.

Temperature.	Pressure in mm. Mercury.	Temperature.	Pressure in mm. Mercury.
700°	1	1,050°	16
730	1·5	1,080	19
820	2·5	1,100	21
880	10	1,150	28
990	12	1,180	38
1,010	14	1,200	41

POTASSIUM CARBONATE.

Temperature.	Pressure in mm. Mercury.	Temperature.	Pressure in mm. Mercury.
730°	0	960°	5
790	0·5	970	9
810	1	1,000	12
890	3	1,090	17

RUBIDIUM CARBONATE.

Temperature.	Pressure in mm. Mercury.	Temperature.	Pressure in mm. Mercury.
690°	0	900°	10
740	2	990	18
830	6	1,020	20
870	8	1,080	33

CÆSIUM CARBONATE.

Temperature.	Pressure in mm. Mercury.	Temperature.	Pressure in mm Mercury.
610°	2	1,000°	44
680	4	1,050	63
805	6	1,090	90
860	8	1,130	121
890	12	1,150	137
930	32	1,180	157

A. F.

448. *Retrogression of Starch.* **L. Maquenne.** (Comptes Rendus, 137. pp. 1266–1268, Dec. 28, 1903.)—Clear starch solution (prepared in an autoclave) passes through a series of retrogressive changes, beginning with a coagulation in which it resembles ordinary opalescent gelatinised starch solution, and in which it is almost completely convertible into maltose by malt extract, and passing by degrees into a final form, amylocellulose, characterised by giving no blue coloration with iodine, and by resisting the solvent and saccharifying influence of diastase. The changes are accelerated by cooling in ice. Alkalies hasten the change in certain concentrations, whilst more concentrated solutions hinder or prevent the "retrogression." The author comes to the conclusion that the so-called starch solutions are in reality colloidal solutions. F. G. D.

449. *Kathodic Deposition of Lead.* **K. Elbs** and **F. W. Rixon.** (Zeitschr. Elektrochem. 9. pp. 267–268, April 2, 1903.)—When lead salts are electrolysed the metal is deposited either in the form of crystalline plates or as a spongy mass of micro-crystalline needles. The authors, in experiments on the electrolysis of phosphorous acid with lead electrodes, have observed that with small current densities the anode goes into solution and at the same time remains bright, and a crystalline deposit of lead forms at the kathode. If the current density is increased the polarisation potential increases from a few tenths of a volt to about 1·9 volts, and at the same time the anode becomes covered with a dark grey layer, and the deposit of lead at the kathode becomes spongy; also plumbic salts are found in the electrolyte. The authors from this and other experiments conclude that spongy lead is produced at the kathode when the electrolyte contains plumbic salts, whereas if the latter are not present, the deposit of lead is crystalline. A solution of lead acetate and sodium acetate in dilute acetic acid gives spongy lead, whereas the badly conducting solution of lead acetate alone gives crystalline lead and contains no plumbic salts. Hypophosphorous acid, which forms a soluble lead salt, gives spongy lead on electrolysis between lead electrodes. The formation of spongy lead on the negative plate of an accumulator must be accompanied by the presence of plumbic sulphate, and the authors have proved the presence of the latter in the accumulator acid. Further experiments show that freshly prepared lead dioxide when stirred up for five hours with sulphuric acid gives the following equilibrium : $PbO_2 + 2H_2SO_4 = Pb(SO_4)_2 + 2H_2O$. The amount of plumbic sulphate found in the accumulator acid is less than that corresponding to this equilibrium, since the spongy lead at the electrode reduces any plumbic sulphate which comes in contact with it. The presence of the plumbic sulphate explains the appreciable "self-discharge" which takes place when an accumulator is left to stand, and also that frequent temperature changes or shakings increase the velocity of this discharge, since convection currents are set up which bring the plumbic sulphate into contact with the spongy lead and thus reduce it. More lead dioxide then goes into solution, forming the disulphate, which is further reduced. T. S. P.

450. *Preparation of Potassium from Fused Potash.* **R. Lorenz** and **W. Clark.** (Zeitschr. Elektrochem. 9. pp. 269–271, April 2, 1903. Communication from the Elektrochem. Laboratorium des eidg. Polytechnikums in Zürich.)—The electrolytic preparation of potassium from fused potash according to the methods used for obtaining sodium from caustic soda does not give successful results. Le Blanc and Brode have pointed out that the Castner process for sodium, when applied to potassium, does not yield a trace of the latter metal. The authors show that this can be explained by the theory of the electrolysis of fused salts which has been developed by one of them (R. Lorenz). According to this theory the metal which is deposited at the kathode is partially dissolved by the fused salt, and partially transformed into the so-called "metal fog," so that the fused electrolyte is filled with a more or less fine metallic fog or vapour. This fog spreads out from the kathode to the anode, and at the latter combines with the deposited anions to re-form the original substance; *e.g.*, in the case of the electrolysis of fused lead chloride, a black fog of metallic lead is formed at the kathode and gradually spreads through the electrolyte to the anode, where lead chloride is again formed. This process will reduce the polarisation and also the yield. In the case of small current densities the potential at the kathode can be so much diminished that sometimes no metallic lead is deposited at the kathode, but simply forms a fog round it. The higher the temperature and the greater the vapour pressure of the metal the more likely is such a process to take place. This theory will account for the facts observed in the electrolysis of fused caustic potash. At the same temperature the vapour pressure of potassium is higher than that of sodium, and consequently the formation of the "metal fog" is much greater and lowers the yield. If the kathode is surrounded by a capsule of some kind, the diffusion of the fog to the anode should be prevented and the yield of the metal increased. The authors have obtained a 58 per cent. yield of potassium from potash by using such a capsule of magnesite, in the form of an inverted crucible, round the kathode of iron wire. Sodium when prepared in a like manner gives better yields than those ordinarily obtained. An attempt to prepare barium from baryta was not successful, the only product being barium oxide. Fused sodium chloride also gave sodium, but the chlorine evolved at the anode rapidly attacked the magnesite capsule. [See also Abstract No. 175 (1903).] T. S. P.

451. *Behaviour of Diaphragms in the Electrolysis of Salt Solutions.* II. **W. Hittorf.** (Zeitschr. Phys. Chem. 43. pp. 239–249, April 3, 1903.)—When no membrane was used the following values were obtained for the transportation values [those for cadmium chloride were incorrectly given in the earlier paper, see Abstract No. 770 (1903)].

Solution.	Transport Value. Anion.	Transport Value. Kation.
$CdCl_2$ + 1·1398 parts water …………………	1·137	−0·137
$CdCl_2$ + 2·6896 ,, ,, …………………	0·801	0·199
$CdCl_2$ + 3·943 ,, ,, …………………	0·724	0·276
$CdCl_2$ + 14·522 ,, ,, …………………	0·589	0·411
CdI_2 + 2·2632 ,, ,, …………………	1·245	−0·245
$ZnCl_2$ + 1·8184 ,, ,, …………………	1·241	−0·241

The strongest solution of cadmium chloride and the strong solutions of cadmium iodide give negative transport values for the anion, a result which may be explained by the formation of complex salts $\overset{++}{Cd}/\overset{--}{CdCl_4}$, $\overset{++}{Cd}/\overset{--}{CdI_4}$, $\overset{++}{Zn}/\overset{--}{ZnCl_4}$. Water is carried through animal membranes in the direction of the current, but aqueous solutions are carried through in the opposite direction, the amount of water transmitted increasing with the dilution. In the case of solutions of cadmium chloride the solution carried through the membrane by the current is very concentrated; in a solution in 135 parts of water the solution carried through the membrane was 4½ times this concentration, and when dissolved in 414 parts of water the concentration was increased nine-fold. T. M. L.

452. *Formation of sparingly Soluble Precipitates, especially of White Lead, in Electrolysis with Soluble Anodes. Cause of Unipolar Conduction.* **A. Isenburg.** (Zeitschr. Elektrochem. 9. pp. 275–283, April 9, 1903. Communication from the Physikalisch-Chemischen Inst. der Technischen Hochschule, Karlsruhe.)—Lead chromate can be prepared by the action on a lead anode of a mixture of a soluble chlorate in excess with a small amount of soluble chromate; under these conditions the chromate is precipitated and the anode remains clean, but if the concentration of chromate is increased, the lead chromate adheres to the anode and lead peroxide is also formed. [See Le Blanc and Bindschedler, Abstract No. 177 (1903).] In a similar manner lead carbonate can be prepared by electrolysing a mixture of $NaClO_3$ and Na_2CO_3 and passing in carbon dioxide; in a 1·5 per cent. solution of 80 per cent. $NaClO_3$ and 20 per cent. Na_2CO_3 there is a theoretical yield of carbonate which adheres loosely to the anode, and the p.d. does not exceed 2·3 volts, but with 50 per cent. Na_2CO_3 lead peroxide is formed, the yield falls to 92 per cent., and the p.d. rises to 7 volts; with 90 per cent. Na_2CO_3 the yield of $PbCO_3$ is only 20 per cent., much PbO_2 is formed, and the p.d. is 4·5 volts; with pure sodium carbonate only PbO_2 and oxygen are produced, and the p.d. is steady at 2·3 volts. Under some conditions the p.d. rises to 30 volts, and the cell behaves very much like an electrolytic rectifier; the two cases appear, however, to be distinct, as the aluminium anode exhibits a distinct condenser-action. White lead can only be obtained by moderating the supply of carbon dioxide; for instance, by admixture with air. T. M. L.

453. *Decomposition of the Anode.* **E. Wohlwill.** (Zeitschr. Elektrochem. 9. pp. 311–332, April 23, 1903.)—A series of experiments was made to determine the ratio of the normal loss in weight of the anode under different conditions to the additional loss caused by mechanical loss of material in the form of anode slime. In the case of copper electrodes immersed in sulphuric acid, copper sulphate, or dilute nitric acid, the percentage of mechanical loss varied from 2 to 23 per cent. The current density is the most important factor, and in one series of experiments a five-fold increase of current density decreased the loss from 15·3 to 2·8 per cent.; a copper anode exhibited at the Hamburg Naturforscherversammlung, which had been partially dissolved at 0·31 amperes per sq. cm., showed a surface like a file, whilst an anode partially dissolved at 1·37 amp./dm.^{2} retained its original smooth surface. A decrease in the strength of the electrolyte causes a great reduction in the loss when the current density is kept constant—a result which can be explained by the tendency of the current to take the shortest path and dissolve all projecting points; the loss is also less in a copper sulphate bath than in sulphuric acid. An initial polishing of the anode also serves to reduce the loss of material by crumbling. T. M. L.

454. *Electrolytic Oxidation of* p-*Toluenesulphonic Acid.* **J. Šebor.** (Zeitschr. Elektrochem. 9. pp. 370–373, April 30, 1903. From the Chem. Laboratorium der k.k. böhm. Technischen Hochschule, Prag.)—On electrolysing *p*-toluenesulphonic acid in sulphuric acid solution with a platinum anode, very little *p*-sulphobenzoic acid is formed, and under the most favourable conditions, especially at high temperatures, more than 80 per cent. of the electrolytic oxygen is evolved. With lead peroxide anodes the gas evolution is much diminished, but the amount of sulphobenzoic acid formed never exceeds 80 per cent. of the theoretical yield, as it undergoes further oxidation, giving off carbon dioxide. T. H. P.

455. *Electrolytic Separation and Estimation of Zinc.* **A. Hollard.** (Chem. News, 87. p. 259, May 29, 1903. Bull. Soc. Chim. 3. 29. No. 7.)—A brief description of the method used by the author of separating zinc from iron, and aluminium from zinc. In both cases the mixtures or alloys are reduced to solutions of sulphates of the metals, to which potassium cyanide is added, and soda in excess to render them alkaline; the double cyanide of potassium and zinc being thus formed. The iron should be ferric, in which case it is practically all precipitated in large excess of soda. Data as to the quantities used are given. The zinc is deposited with a current of 0·1 ampere on platinum gauze kathodes, copper-plated to prevent adherence of the zinc. The deposit is of a beautiful bluish-white colour, and can be obtained thick without any trouble, deposits of 1 gramme being quite possible. In separating zinc from iron, the process has to be repeated on the iron precipitate, as this retains traces of the zinc after electrolysis. The accuracy of the method is shown by the following examples: (*a*) Zinc in solution, 1·0007 gm.; iron, 0·1 gm.; deposit, 0·9939 gm.; iron in deposit, 0·0006 gm.; (*b*) zinc in alloy, 0·5001 gm.; aluminium, 0·5 gm.; weight of deposit, 0·5094 gm. The iron was in the form of ferric sulphate, and the zinc contained 0·18 per cent. of lead. Another method is described, in which the sulphate solution is treated with organic salts and slight excess of acetic acid; but it is not applicable in the presence of iron, or easy in the presence of aluminium. [See also Abstract No. 1512 (1903).] J. D. C.

456. *Rotating Kathodes in the Electrolytic Determination of Metals.* **F. A. Gooch** and **H. E. Medway.** (Zeitschr. Anorg. Chem. 35. 4. pp. 414–420, July 8, 1903.)—Rotating kathodes having frequently been used to obtain metallic deposits in a compact form in connection with soluble anodes, the authors suggest using such kathodes in analytical separations in order to eliminate metals completely from their solutions. In such cases, insoluble anodes being used, the fairly high e.m.f.'s required to overcome the resistance and to accelerate the separation of the metal, result in a considerable evolution of hydrogen, so that the metal is not deposited in a compact and adherent form. The authors endeavour to eliminate the disturbing effect of the evolution of hydrogen by the use of a rotating kathode, so that, even in the case of high current densities, adherent and homogeneous deposits, available for analytical purposes, are formed in a short time. An ordinary platinum crucible rotating at about 600 to 800 r.p.m. is used as a kathode, the crucible being driven by a small electromotor, arranged so as to have its shaft vertical. The crucible was attached to this shaft by means of a rubber stopper the central boring of which was traversed by the shaft. To ensure electrical contact between the crucible and the shaft, a narrow slip of platinum sheet was soldered to the shaft, bent upwards beside the stopper, and clamped between the latter and the crucible. The shaft is made in two parts (so that the crucible may be readily dismounted), both being connected by rubber tubing. The solution to be electrolysed is placed so that the crucible may be immersed in the liquid to any desired depth. Platinum sheet, connected with the positive pole of a battery of four accumulators connected in series, is used as an anode, the negative pole of the battery being connected to the bearing of the shaft. It is inferred from the results that nickel, as well as copper and silver are rapidly and completely precipitated by this process. The deposits of these metals obtained on rotating kathodes are sufficiently coherent and compact to allow of accurate work and weighing, even with a high and variable current density at the kathodes. Other metals show a similar behaviour. A. G.

457. *Electrolysis of Molten Lead Chloride.* **A. Appelberg.** (Zeitschr. Anorg. Chem. 36. 1. pp. 36–76, July 23, 1903.)—According to Helfenstein's investigations, the causes of the losses in current output are as follows: Lead in a fused state, is susceptible of being partly dissolved in the molten mass and partly carried in the form of so-called metal fogs to both the anode and the surface of the electrolyte. These sources of error may be eliminated by the use of partition walls. The theory of the phenomena connected with what he terms "residual currents" has been studied by R. Lorenz [see Abstracts Nos. 746 and 1756 (1902)]. The author infers from these results that a certain connection must exist between the current density and output, as the variation in the velocity of recombination with the intensity of the current is relatively smaller than the corresponding alteration of the electrolytic deposit. In the electrolysis of molten lead chloride in an ordinary **V**-tube, the output in lead accordingly decreases regularly with decreasing densities of the current. This variation of the current output with the current density is less in the case of higher intensities, increasing with decreasing densities of the current. The output curve does not pass through zero, but cuts the axis of abscissæ, the intersection point indicating the intensity for which no output is obtained. The minimum intensity thus found corresponds with the minimum pressure, *i.e.*, the pressure at the terminals for which the output disappears. The minimum intensity of the current is not an absolute quantity, but is variable according to the conditions of experiment. The author determines the outputs in chlorine for variable current density, the agreement with the corresponding outputs in lead being satisfactory for higher densities, whereas discrepancies are observed in the case of lower densities. In the electrolysis of a eutectic mixture of $PbCl_2$ and KCl no formation of lead fogs is observed. The decrease in the current output with decreasing current densities is, in **V**-tubes as well as in cylindrical ones, much slower than in the case of pure lead chloride. The phenomena are well represented by a formula given by Lorenz, viz., $a = 100 - k/i^n$, where a is the percentage output, k and n being two constants which have to be calculated, and i is the current density. The outputs as found by experiment and as calculated from the above formula show a satisfactory agreement.

A. G.

458. *Electrolysis of Sulphuric Acid, using Large Current Densities.* **E. Gehrcke.** (Deutsch. Phys. Gesell., Verh. 5. 15. pp. 263–266, Aug. 15, 1903.) —In the course of investigations on the hydrogen spectrum the author has noticed that hydrogen prepared from dilute sulphuric acid by electrolysis is not quite pure, but contains traces of sulphuretted hydrogen. Further experiments have shown that under certain conditions sulphuretted hydrogen, sulphur, and sulphurous acid can be obtained by the electrolysis of dilute sulphuric acid at the ordinary temperature. In the apparatus used to demonstrate this the electrodes consist of (1) a piece of platinum-foil, (2) a platinum wire fused into a piece of glass tubing, which is bent twice at right angles so that the electrode points upwards. A small glass cap fits loosely over the wire electrode. At the beginning of the electrolysis this cap is filled with liquid, but after a short time it becomes filled with gas, and thus diminishes the area of the electrode in contact with the electrolyte. Thus by raising or lowering this cap any current density can be attained. Two series of experiments were carried out, the voltage used being 110. In the first series the wire electrode is the kathode. The current at first amounts to several amperes, but as the cap becomes filled with hydrogen it rapidly sinks to only a few thousandths of an ampere, the apparatus then acting as a Wehnelt interrupter. After twenty to thirty hours the electrolyte becomes cloudy from the deposition of sulphur; there is also a deposition of sulphur at the bottom of the cell and on the glass tube containing the kathode. The electrolyte also smells strongly of sulphuretted hydrogen. In the second series the wire electrode is the anode. The current falls rapidly as before, and in the cap round the anode sulphurous acid is formed. After a few hours the liquid becomes cloudy and dirty brown. Sulphuretted hydrogen is evolved at the kathode, and a deposit of sulphur forms at the bottom of the cell. The dilutions of acid used were 1 : 4–1 : 6, these solutions possessing the maximum conductivity. Stronger or weaker solutions require a much longer time to give the above results. At great dilutions, such as 1 : 25, the reactions described do not take place. The reaction may be caused by high local temperature at the wire electrode; it is also possible that the high potential differences at the points of maximum current density may play a part.

T. S. P.

459. *Behaviour of so-called Unpolarisable Electrodes towards the Alternating Current.* **E. Warburg** and **B. Strasser.** (Deutsch. Phys. Gesell., Verh. 5. 16. pp. 269–275, Aug. 30, 1903.)—Only in a few cases has the behaviour of so-called unpolarisable electrodes (*e.g.*, zinc in zinc sulphate) towards the alternating current been in agreement with the theory; in most cases the agreement is not even approximate. The authors find that at first the behaviour of an electrode of zinc amalgam against a solution of zinc sulphate corresponds to the theory, *i.e.*, the polarisation capacity is inversely proportional to the square root of the number of alternations, and directly proportional to the concentration; the absolute value of the capacity is about two-thirds of the theoretical value, and the corresponding self-induction amounts to 2×10^6 cm. After fourteen hours the latter has risen to 30×10^6 cm., and the other laws do not hold at all. This change is accompanied by a considerable increase in the resistance of the cell. Electrodes of copper wire in copper sulphate, and cadmium-foil in cadmium sulphate, give similar results. The increase in resistance can be explained by the formation of a badly conducting layer on the electrode, as has been pointed out by Wien, and as this layer possesses a definite dielectric constant, it represents a conducting condenser the relatively small dielectric capacity of which can mask the large electrolytic capacity. The authors have calculated the resistance and dielectric capacity of such condensers from observations on cells of liquid zinc amalgam—zinc sulphate and cadmium-foil—cadmium sulphate, assuming that all the observed polarisation capacity is of a dielectric nature. The dielectric capacity remains approximately constant, while the compensating self-induction increases from two- to sixteen-fold with diminishing current strength. The thickness of the layers is calculated to be 0·107 × 10^{-7} cm. in the case of the zinc amalgam, and 0·466–209 × 10^{-7} cm. for the cadmium cell. T. S. P.

460. *Potential of Ozone.* **L. Graefenberg.** (Zeitschr. Anorg. Chem. 36. 3. pp. 355–380, Sept. 16, 1903.)—In this paper the formation of ozone in the electrolysis of fluoric acid is investigated, it being shown that, as in the electrolysis of sulphuric acid, the percentage of ozone in the oxygen evolved will increase with the current density, though not proportionally. The output at ordinary temperatures remains below 5·2 per cent., this being little more than is obtained with sulphuric acid. The corrosion of all metals capable of being used as anodes will account for these unsatisfactory figures. The oxidation potential of ozone is then determined by different methods, the e.m.f. of about 10 per cent. ozone against hydrogen being 1·65 volts. It is shown that the same oxidising agent is capable of developing either oxygen or ozone, according as the chemical potential of the oxidising agent is above or below the ozone potential. From the potential measurements a new theory of the formation of ozone is developed, and its agreement with existing facts evidenced. According to this theory, the ozone electrode would be reversible with regard to HO-ions. The existence of free ozonic acid H_2O_4, as a consequence of this theory, is probable. A. G.

461. *Influence of Electrolytes and Electrodes on Ozone Formation.* **R. Kremann.** (Zeitschr. Anorg. Chem. 36. 3. pp. 403–412, Sept. 16, 1903.)—The formation of ozone in sulphuric acid solutions is shown to occur much more readily with lead peroxide points than with platinum points. With the latter, when the concentration of the acid is about 4 molecules per litre, the ozone production is a maximum, whereas with lead peroxide points there is no such maximum. With increasing anode surface the influence of the concentration of the various acids seems to disappear. All the electrode materials used by the author seem to exert an action antagonistic to the formation of ozone, this action being the least in the case of lead peroxide. Sulphuric acid is shown to be the best electrolyte for ozone formation with such electrodes as were used. With phosphoric acid, lead peroxide electrodes, and with chromic acid, platinum electrodes proved most advantageous. Ozone is formed from potassium hydroxide in appreciable amounts only at low temperatures and with platinum points, the amount being a maximum for a solution containing 1 molecule per litre. A. G.

REFERENCES.

462. *Relations between Atomic Weights.* **R. J. Hughes.** (Chem. News, 88. pp. 298–299, Dec. 18, 1903.)—The elements are supposed to be built up from corpuscles according to certain types drawn by analogy from the radicles NH_4, CN, CH, and NH. Calculations are made on this basis. For these reference must be made to the original. F. G. D.

463. *Comparative Studies in the Periodic System.* **G. Rudorf.** (Zeitschr. Anorg. Chem. 37. 1. pp. 177–199, Oct. 27, 1903.)—The author considers that the small periods should not be directly compared with the great periods, apart from material differences shown by the latter among themselves. The helium elements are shown to form a special group, most likely preceding the alkalies ; these elements do not therefore form a part of the ordinary eighth group. A. G.